



MEMORANDUM

April 11, 2011

To: Dr. Aldos C. Barefoot
E. I. du Pont de Nemours and Company
Wilmington, Delaware 19898
U.S.A.

From: Nathan J. Snyder, Amy M. Ritter, P.E., Dr. Cornelius G. Hoogeweg,
and Kevin N. Wright
Waterborne Environmental, Inc
897-B Harrison Street, S.E.
Leesburg, VA 20175
USA

Title: Summary of Hexazinone California Use and Groundwater
Concentrations (Monitoring and Modeling)

This memorandum is submitted to E.I. du Pont de Nemours & Company in support of their response to a November 1, 2010 Notice of Hexazinone Residue Detections in California Groundwater and Registrant Opportunity to Request a Hearing ("Notice") issued by the Department of Pesticide Regulation ("DPR" or "Department") pursuant to the Pesticide Contamination and Prevention Act ("PCPA"), Cal. Food & Agric. Code § 13149. The memorandum includes a review of hexazinone use, monitoring and a modeling analysis.

TABLE OF CONTENTS

Table of Contents.....	2
1.0 Introduction.....	6
2.0 Hexazinone Use in California	6
3.0 Monitoring Data Review.....	6
3.1 National Summary.....	6
3.2 Prospective Groundwater Study and Field Dissipation Studies	6
3.3 CDPR State Summary	7
3.3.1 Review of Detections used for LAU Determination	8
3.3.2 Review of Detections in areas with Documented Use	9
3.3.3 Review of detections in areas with limited use	11
4.0 Modeling of Groundwater Exposure.....	12
4.1 CDPR LEACHP Tool Modeling.....	12
4.2 Spatial Modeling	14
5.0 References	15

TABLES

Table 1	Summary of Hexazinone Detections	17
Table 2	Hexazinone Use and Monitoring Summary in and around COMTRS 10M17S19E36	18
Table 3	Hexazinone Use and Monitoring Summary in and around COMTRS 39M02S06E19	19
Table 4	Hexazinone Use and Monitoring Summary in and around COMTRS 39M02S06E30	20
Table 5	Hexazinone Use and Monitoring Summary in and around COMTRS 24M09S14E23	21
Table 6	Hexazinone Use and Monitoring Summary in and around COMTRS 39M01N05E16	22
Table 7	Hexazinone Use and Monitoring Summary in and around COMTRS 39M02S04E22	23
Table 8	Hexazinone Use and Monitoring Summary in and around COMTRS 48M06N01E23	24
Table 9	Hexazinone Use and Monitoring Summary in and around COMTRS 48M06N01W36	25
Table 10	Hexazinone Use and Monitoring Summary in and around COMTRS 50M04S09E19	26
Table 11	Hexazinone Use and Monitoring Summary in and around COMTRS 50M04S11E31	27
Table 12	Hexazinone Use and Monitoring Summary in and around COMTRS 50M06S08E26	28
Table 13	Hexazinone Use and Monitoring Summary in and around COMTRS 50M07S09E06	29

Table 14	Hexazinone Use and Monitoring Summary in and around COMTRS 10M14S21E21	30
Table 15	Hexazinone Use and Monitoring Summary in and around COMTRS 48M06N01E05	31
Table 16	Hexazinone Use and Monitoring Summary in and around COMTRS 50M07S08E14	32
Table 17	Results of LEACHP Modeling Assessment.....	33
Table 18	Results of PRZM Spatial Modeling Assessment	34

FIGURES

Figure 1	Annual Hexazinone Use Summary by County	35
Figure 2	California Total Annual Hexazinone Use	36
Figure 3	California Total Hexazinone Use on Alfalfa	37
Figure 4	Average Hexazinone Use Rate on Alfalfa (Total Use per Acre Treated)	38
Figure 5	Groundwater Wells in the US; Maximum Residue Levels 1988 to Present.....	39
Figure 6	Intersected Groundwater Wells with Detections with US SSURGO Field-scale Soil Data for Percent Sand.....	40
Figure 7	Hexazinone Groundwater Sample Locations and Reported Usage	41
Figure 8	Hexazinone Groundwater Detections and Samples and Reported Usage.....	42
Figure 9	Monthly Use and Monitoring Results in and around Location COMTRS 10M17S19E36	43
Figure 10	Land-use and Monitoring Locations around COMTRS 10M17S19E36	44
Figure 11	Hydrologic Soil Group and Monitoring Locations around COMTRS 10M17S19E36	45
Figure 12	Monthly Use and Monitoring Results in and around Location COMTRS 39M02S06E19	46
Figure 13	Monthly Use and Monitoring Results in and around Location COMTRS 39M02S06E30	47
Figure 14	Land-use and Monitoring Locations around COMTRS 39M02S06E19 and 39M02S06E30.....	48
Figure 15	Hydrologic Soil Group and Monitoring Locations around COMTRS 39M02S06E19 and 39M02S06E30	49
Figure 16	Monthly Use and Monitoring Results in and around Location COMTRS 24M09S14E23	50
Figure 17	Land-use and Monitoring Locations around COMTRS 24M09S14E23	51
Figure 18	Hydrologic Soil Group and Monitoring Locations around COMTRS 24M09S14E23	52

Figure 19	Monthly Use and Monitoring Results in and around Location COMTRS 39M01N05E16	53
Figure 20	Land-use and Monitoring Locations around COMTRS 39M01N05E16.....	54
Figure 21	Hydrologic Soil Group and Monitoring Locations around COMTRS 39M01N05E16	55
Figure 22	Monthly Use and Monitoring Results in and around Location COMTRS 39M02S04E22	56
Figure 23	Land-use and Monitoring Locations around COMTRS 39M02S04E22	57
Figure 24	Hydrologic Soil Group and Monitoring Locations around COMTRS 39M02S04E22	58
Figure 25	Monthly Use and Monitoring Results in and around Location COMTRS 48M06N01E23	59
Figure 26	Monthly Use and Monitoring Results in and around Location COMTRS 48M06N01W36	60
Figure 27	Monthly Use and Monitoring Results in and around Location COMTRS 48M06N01E05	61
Figure 28	Land-use and Monitoring Locations around COMTRS 48M06N01E23, 48M06N01W36, and 48M06N01E05	62
Figure 29	Hydrologic Soil Group and Monitoring Locations around COMTRS 48M06N01E23, 48M06N01W36, and 48M06N01E05.....	63
Figure 30	Monthly Use and Monitoring Results in and around Location COMTRS 50M04S09E19	64
Figure 31	Land-use and Monitoring Locations around COMTRS 50M04S09E19	65
Figure 32	Hydrologic Soil Group and Monitoring Locations around COMTRS 50M04S09E19	66
Figure 33	Monthly Use and Monitoring Results in and around Location COMTRS 50M04S11E31	67
Figure 34	Land-use and Monitoring Locations around COMTRS 50M04S11E31	68
Figure 35	Hydrologic Soil Group and Monitoring Locations around COMTRS 50M04S11E31	69
Figure 36	Monthly Use and Monitoring Results in and around Location COMTRS 50M06S08E26	70
Figure 37	Monthly Use and Monitoring Results in and around Location COMTRS 50M07S09E06	71
Figure 38	Monthly Use and Monitoring Results in and around Location COMTRS 50M07S08E14	72
Figure 39	Land-use and Monitoring Locations around COMTRS 50M06S08E26, 50M07S09E06, and 50M07S08E14	73
Figure 40	Hydrologic Soil Group and Monitoring Locations around COMTRS 50M06S08E26, 50M07S09E06, and 50M07S08E14	74

Figure 41	Monthly Use and Monitoring Results in and around Location COMTRS 10M14S21E21	75
Figure 42	Land-use and Monitoring Locations around COMTRS 10M14S21E21	76
Figure 43	Hydrologic Soil Group and Monitoring Locations around COMTRS 10M14S21E21	77
Figure 44	Projected Groundwater Concentration using DPR LEACHP Tool; 125% Target Irrigation and Variable Travel Times	78
Figure 45	Projected Groundwater Concentration using DPR LEACHP Tool; 160% Target Irrigation and Variable Travel Times	79
Figure 46	Maximum Predicted Well Concentration (3-Year Travel Time)	80
Figure 47	Maximum Predicted Well Concentration (4-Year Travel Time)	81
Figure 48	Maximum Predicted Well Concentration (5-Year Travel Time)	82
Figure 49	Maximum Predicted Well Concentration (10-Year Travel Time)	83

SUMMARY OF HEXAZINONE CALIFORNIA USE AND GROUNDWATER CONCENTRATIONS (MONITORING AND MODELING)

1.0 INTRODUCTION

California Department of Pesticide Regulation (DPR) published a memorandum outlining the history and current status of hexazinone detections in groundwater monitoring in California which were used to make a Legal Agricultural Use (LAU) determination. Additionally, they summarized detections in monitoring programs attributed to point sources, runoff collection ponds, and many that were isolated from any other detection. This memorandum provides additional context to the existing monitoring data, provides analysis thru modeling to assess a broader exposure estimate than is feasible with monitoring, and provides a framework to place the limited detections into a broader context.

2.0 HEXAZINONE USE IN CALIFORNIA

Hexazinone is labeled for use in California at a maximum rate of 1.5 lb ai/ac/year on clay and loam soils with organic matter contents greater than 0.5 percent. The maximum rate on coarse soils is 0.7 lb ai/ac/year. Use is prohibited on gravelly, rocky, or sand soils. Use is also prohibited in California seed alfalfa where organic matter content is less than 1 percent. A maximum rate of 0.5 lb ai/ac/year is allowed on seed alfalfa grown on sandy loam or loamy sand soils with between 1 and 2 percent organic matter

The California Pesticide Use Report (PUR) database (CDPR, 2011) was queried for hexazinone use and used to create annual summaries of use for the major counties (Figure 1) and for the entire state (Figure 2). Alfalfa is the major use crop and is summarized at the state level (Figure 3) and as an average rate (total pounds per total acre treated) (Figure 4). Use has been relatively stable with total pounds generally staying between 100,000 and 120,000 pounds for eight of the last 10 years (2000-2009). In alfalfa, total annual use has fluctuated in a range of 55,000 to 80,000 pounds over the same time period.

3.0 MONITORING DATA REVIEW

3.1 *National Summary*

Miller et al (2010) provided a summary of national scale databases with monitoring for hexazinone. While the focus was the relevance to Canadian conditions in response to PMRA data requirement, the information gathered provides a national scale summary showing the extent of monitoring and detections from national scale databases. The CDPR state database was not included in this summary. The national hexazinone sampling found a very low detection frequency with 97.6% of samples were non-detects in the NAWQA database and 98% were non-detects in the USGS NWIS database. The 95th percentile of detects was 0.172 ppb and 0.2 ppb for the NAWQA and USGS NWIS databases, respectively.

3.2 *Prospective Groundwater Study and Field Dissipation Studies*

A groundwater study was conducted for hexazinone as a requirement of USEPA registration in Merced County, CA. (Hanson et. al., 2000)). An application of

0.75 pounds/ac was applied in January of 1996 to an alfalfa field consisting of loamy sands and sands. Irrigation and rainfall combined to exceed evapotranspiration. A maximum concentration of 9.2 ppb was observed in one well at a time the water table was approximately 12 feet below the land surface. Areas of the field with heavier soils saw lower well concentrations with maximums below 1 ppb. The monitoring wells were located within the field and no additional sampling was conducted outside of the application area to quantify off-site expected environmental concentrations in groundwater.

Two field dissipation studies were conducted at three locations near Greenville, MS, Newark, DE, and Madera, CA for hexazinone (Bollin, 1992a and Bollin, 1992b). The three studies received application rates of 12 pounds a.i. per acres, well above current label rates. The Newark, DE study conducted on a silt loam resulted in a 123 day half-life. The Greenville, MS study conducted on a silty clay loam resulted in a 154 day half-life. The Madera, CA study conducted on a sandy loam resulted in a 140 day half-life. Residues were not found in the bottom samples layers in the Newark, DE or Greenville, MS sites and the reported rainfall (and irrigation) was 94% and 104% of historical averages for the two sites respectively. Evapotranspiration was not determined, but given the annual average rainfalls of 43.37 for the Newark, DE site and 52.05 inches for the Greenville, MS site, adequate water for leaching was available. Although there were detectable residues early in the Madera, CA study at lower soil depths, they were attributed to contamination from the surface and once irrigation started and actual leaching was anticipated, the actual movement did not occur to the bottom of the sampled depths. The quantification of irrigation input and site ET was inadequate to definitively determine if adequate water was supplied to assess leaching, although from the residues, the derived degradation rate is applicable to California field conditions.

3.3 *CDPR State Summary*

As part of the CDPR groundwater monitoring program, hexazinone has been evaluated in 3,800 samples from 2300 wells with detects ranging from 0.05 (the detection limit) to 0.27 parts per billion (ppb) in 26 wells (Nordmark and Quagliaroli, 2010). The summary presented in the memorandum highlights the conditions surrounding the 26 wells with detections including follow-up sampling used to make a determination of Legal Agricultural Use (LAU) and existence of documented hexazinone applications. In addition to the detects, it is important to note the extensive distribution of samples in areas receiving hexazinone applications (Figure 7 and Figure 8) and the limited number of detections (1.1 % of sampled wells). The classification of the samples is shown in Table 1 and with their locations in relation to use in Figure 8. A total of 15 wells with detections occurred in areas with documented use in both the sampled section as well as those surrounding the sampled section. Three of those sections were used to make a determination of LAU. Three sampled sections had a well with detection where no applications occurred within the section, but some applications occurred in neighboring sections. Three sampled sections had a well with detection with no documented use in the sampled or neighboring sections. The CDPR memorandum includes discussion of two sets of samples that were considered the result of point sources (four wells in two sections) or runoff collection ponds providing a leaching pathway (two wells in two sections) and are not discussed further in this document.

A database of all hexazinone sample data was provided by personal communications from Craig Nordmark (CDPR) to Aldos Barefoot (DuPont Crop Protection) on January 11, 2011 (Nordmark, 2011). These data enabled a more detailed assessment of the timing of detections in relation to use and information on spatial context of detections and non-detections. The specific sampling data, along with the information in the memorandum, and public data sources were used to create a series of data summaries useful for discussing the individual sections with detects. For each detection location, a graph (and table) of the time series of use and monitoring was created, along with a map of land use and soil hydrological soil groups. The exact well locations are estimates from the locations given in the memorandum maps (Nordmark and Quagliaroli, 2010) and are not tied to specific points in the provided database (exact well locations were not provided).

3.3.1 Review of Detections used for LAU Determination

Location 10M17S19E36

Table 2 and Figure 9 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. Three wells within the section were sampled once and had a detectable sample with a maximum of 0.247 ppb. One well was sampled twice, once prior and once at the same time as the detections, with no detectable hexazinone concentrations. Fourteen samples from 10 wells were sampled in surrounding sections without showing additional detections. Use was present before the sampling times and alfalfa is a common crop in the area of sampling (Figure 10). The section with the detection is not listed in CDPR groundwater protection areas (GWPA) although five of the surrounding sections are GWPA. SSURGO data are not available for this area of California. This section has a history of hexazinone use and alfalfa production and no point sources were found during the field surveys. The source has been evaluated by CDPR and determined to be due to LAU (Nordmark and Quagliaroli, 2010).

Location 39M02S06E19 and 39M02S06E30

Table 3, Table 4, Figure 12, and Figure 13 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within each section had a detectable sample with a maximum of 0.072 ppb in 39M02S06E19 and 0.093 ppb in 39M02S06E30. Two wells were sampled once each, prior to the detections, with no detectable hexazinone concentrations in section 39M02S06E19. Detections were reported in memorandum (Nordmark and Quagliaroli, 2010) but were not included in groundwater monitoring database provided (Nordmark, 2011). Eighteen samples from 15 wells in the surrounding sections resulted in 3 detections; all of which were determined to be transitory (Gosselin, 1997) or due to agricultural drainage ponds (Prichard, et al, 2005). Use was present before the sampling times and alfalfa is grown near to the area of sampling (Figure 14). The soil in the area was generally hydrologic group D (Figure 15) meaning it is not prone to leaching. Section 39M02S06E19 with the detection is listed in CDPR groundwater protection areas (GWPA) while section 39M02S06E30 is not listed in CDPR GWPA. These new detections have been investigated and determined to be due to LAU (Nordmark and Quagliaroli, 2010). All sections have a history of hexazinone use on alfalfa and all sections have runoff ponds present but no evidence of point source contamination was found.

3.3.2 *Review of Detections in areas with Documented Use*

Location 24M09S14E23

Table 5 and Figure 16 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.11 ppb. Two wells were sampled with no detectable hexazinone concentrations, at a later time. Three samples from 3 wells were sampled in surrounding sections at a later time without showing additional detections. Use was present before the sampling times and alfalfa is a major crop in the area of sampling (Figure 17). The soil in the area was generally hydrologic group B (Figure 18) meaning it is prone to leaching. The other wells within the same section also lie on similar soils. The section with the detection is listed in CDPR groundwater protection areas (GWPA).

Location 39M01N05E16

Table 6 and Figure 19 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.092 ppb. One well in the same section was sampled at the same time with no detectable hexazinone concentrations. Two samples from 2 wells were sampled, at the same time as the detection, in a surrounding section without showing additional detections. Use was present before the sampling times and alfalfa is a common crop in the area south of sampling (Figure 20). The soil in the area was generally hydrologic group C (Figure 21) meaning it is not prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 39M02S04E22

Table 7 and Figure 22 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.096 ppb. Four wells were sampled once each at a later date with no detectable hexazinone concentrations. One sample from 1 well was sampled in a surrounding section without showing additional detections. Use was present before the sampling times and scattered alfalfa is a common crop north of the area of sampling (Figure 23). The soil in the area was generally hydrologic group D (Figure 24) meaning it is not prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 48M06N01E23

Table 8 and Figure 25 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.126 ppb. One other well was sampled, at an earlier time, with no detectable hexazinone concentrations. Five samples from 5 wells were sampled in surrounding sections, at either the earlier or same time as the detection occurred, without showing additional detections. Use was present before the sampling times and alfalfa is a common crop in the area of sampling (Figure 28). The soil in the area was generally hydrologic group D (Figure 29) meaning it is not prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 48M06N01W36

Table 9 and Figure 26 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had detectable samples in 2 out of 3 samples taken on the same day. The maximum of the detections was 0.092 ppb. Six wells were sampled, 3 at the same time as the detection and 3 at a later date, with no additional detectable hexazinone concentrations. Six samples from 6 wells were sampled in surrounding sections, at a later date, without showing additional detections. Use was present before the sampling times although in 2007, alfalfa did not appear as a major crop in the area of sampling (Figure 28). The soil in the area was generally hydrologic group D (Figure 29) meaning it is not prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 50M04S09E19

Table 10 and Figure 30 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had 2 detectable samples, taken on the same day, with a maximum of 0.27 ppb. Four wells were sampled at a later date with no detectable hexazinone concentrations. Two samples from 2 wells were sampled in the surrounding sections at a later date without showing additional detections. Use was present before the sampling times, and alfalfa is an intermittent crop in the area of sampling (Figure 31). The soil in the area was generally hydrologic group A (Figure 32) meaning it is prone to leaching. One of the other wells in this section was on the same soil but farther away from alfalfa, two others were closer to the alfalfa but on different types of soil. The section with the detection is listed in CDPR groundwater protection areas (GWPA).

Location 50M04S11E31

Table 11 and Figure 33 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.263 ppb. A prior sample at the same well showed no detection of hexazinone concentrations. Four other wells, 7 samples revealed no detectable hexazinone concentrations, samples were taken before and at the same time as the detection. Nine samples from 7 wells were sampled in the surrounding sections without showing additional detections. Use was present before the sampling times, and alfalfa is a common crop to the west of the area of sampling (Figure 34). The soil in the area was generally hydrologic group B (Figure 35) meaning it is prone to leaching. Several of the other wells were on the same classification of soil but are further from the alfalfa fields. The section with the detection is listed in CDPR groundwater protection areas (GWPA).

Location 50M06S08E26

Table 12 and Figure 36 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.062 ppb. Three wells were sampled once each, one prior to and the others at the same time as the detection, with no detectable hexazinone concentrations. Nine samples from 8 wells were sampled in the surrounding sections, both prior to and after the detections occurred, without showing additional detections. Use was present before the sampling

times, and alfalfa is a sparse crop in the area of sampling (Figure 39). The soil in the area was generally hydrologic group B (Figure 40) meaning it is prone to leaching. All wells in this section are on similar soil and most within similar proximity to alfalfa fields. The section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 50M07S09E06

Table 13 and Figure 37 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.094 ppb; a prior sample at the same well had no detection. One other well was sampled, prior to the detection, with no detectable hexazinone concentrations. Eight samples from 7 wells were sampled in surrounding sections, both prior to and at a similar time to the detection, without showing additional detections. Use was present before the sampling times, and alfalfa is a common crop in the area of sampling (Figure 39). The soil in the area was generally hydrologic group B (Figure 40) meaning it is prone to leaching. The other well in the section is in the same soil and has the same proximity to alfalfa. The section with the detection is not listed in CDPR groundwater protection areas (GWPA).

3.3.3 *Review of detections in areas with limited use*

Location 10M14S21E21

Table 14 and Figure 41 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had detectable samples, 3 out of 15 samples taken over several years, with a maximum of 0.063 ppb. Three samples, taken prior to the first detection, from 2 others wells had no detectable hexazinone concentrations. Seventeen samples from 3 wells were sampled in the surrounding sections over the same time frame without showing additional detections. Use was present before the sampling times but none in almost a decade preceding sampling. Alfalfa is not a crop in the area of sampling (Figure 42). There are no SSURGO soil data in the area of sampling (Figure 43) but the section with the detection is listed in CDPR groundwater protection areas (GWPA).

Location 48M06N01E05

Table 15 and Figure 27 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section had a detectable sample with a result of 0.094 ppb. Three other wells were sampled once at a later date with no detectable hexazinone concentrations. Seven samples from 6 wells were sampled in the surrounding sections both before and after the detection occurred without showing additional detections. Use was present before the sampling times, and alfalfa is present to the east in the area of sampling (Figure 28). The soil in the area was generally hydrologic group D (Figure 29) meaning it is not prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

Location 50M07S08E14

Table 16 and Figure 38 provide monthly summaries of use from the Pesticide Use Reports (CDPR, 2011) database and sampling data. One well within the section

had 2 detectable samples, taken at different times, with a maximum of 0.073 ppb. No other wells were sampled in the same section. Seven samples from six wells were sampled in the surrounding sections without showing additional detections. Use was present before the sampling times, but not for nearly 8 years before the detection. Alfalfa is a common crop in the area of sampling (Figure 39). The soil in the area was generally hydrologic group B (Figure 40) meaning it is prone to leaching and the section with the detection is not listed in CDPR groundwater protection areas (GWPA).

4.0 MODELING OF GROUNDWATER EXPOSURE

4.1 CDPR LEACHP Tool Modeling

The California Department of Pesticide Regulation (CDPR) uses probabilistic based modeling to determine the leaching potential of a pesticide (Troiano and Clayton, 2009). This probabilistic modeling approach produces a cumulative distribution for 1000 predicted well water concentrations. If the value at the 95th percentile is greater than or equal to 0.05 µg/L, then the active ingredient is determined to have a high potential to contaminate groundwater. If the 95th percentile is less than 0.05 µg/L, the active ingredient is determined to have a low potential to be detected in ground water.

Determination of the leaching potential requires three steps:

- In the first part, the distribution of the annual amount of pesticide leached below 3 meters is calculated from 1000 random combinations of laboratory derived K_{oc} and terrestrial field dissipation (TFD) half lives of the pesticide. The 1000 random combinations are generated from a triangular distribution using minimum, maximum and median/mode of the K_{oc} and half lives. LEACHP is used to calculate pesticide concentration under two water application scenarios of 160% and 125% of the crop (grape) need. An inefficient irrigation management practice is represented by the addition of water at 160% of crop water requirements. An efficient irrigation management practice is represented by addition of water at 125% of crop need. SENSAN model is used to run 1000 LEACHP runs.
- In the second part, residues are aged according to an estimate for the amount of time it takes for water to migrate from the 3-meter depth to wells. The concentration of residue in well water from each LEACHP simulation is determined using following equation:

$$\text{Well water concentration } (\mu\text{g/L}) = (M_L * 0.5^N) / D$$

where:

- M_L = annual mass of product leached below root zone as determined by LEACHP (mg/m²);
- N = number of product dissipation half-lives during transport in the vadose zone and during aging and in the aquifer until arrival at a well (i.e. Travel Time in Days/Half-life);
- D = depth of annual ground water recharge (0.5 m).

The estimated travel times to a well are 10 and 13 years for the 160% and 125% irrigation water management treatments, respectively. The

value of N in the above equation is calculated as total travel time divided by the longest TFD half-life. The calculations in the second part are done using a FORTRAN code.

- In the third part, the cumulative distribution for the predicted 1000 well water concentrations is constructed. If the value at the 95th percentile is greater than or equal to 0.05 µg/L, then the active ingredient is determined to have a high potential to contaminate ground water; otherwise, it is determined to have a low potential to be detected in ground water.

The source data for the hexazinone analysis were derived from the CDPR environmental fate summary (Ganapathy, 2006) and USEPA's environmental fate summaries (Woodard Meléndez, 2010). For modeling, 1000 random combinations were generated using triangular distributions with the following data:

Soil	Koc (mL/g)	Source
Tama SiL	38	Woodard and Melendez, 2010
Chino L	75	
Trevino SL	77	
Sassafras SL	40	

Location	First-order Half-life (days)	Source
Newark, DE	123	DuPont 1474-89
Greenville, MS	154	DuPont 1474-89
Madera, CA	140	DuPont 1923-91

Additional required data are as follows:

Parameter	Value	Source
Vapor Pressure	1.9×10^{-7} mmHg	Ganapathy/CDPR 1996
Solubility	29,800 ppm (@25°C)	Ganapathy/CDPR 1996
Henry's Constant	2.1×10^{-12} atm-m ³ /mole	Ganapathy/CDPR 1996
Molecular Weight	252.32 g	Ganapathy/CDPR 1996
Vapor Density	2.56E-6 mg/L	Calculated*

*Vapor density (mg/L) = solubility (mg/L) * 4.034E-4 (mol/ Pa-m3) * Henry's constant (Pa-m3/mole)

To determine the leaching potential for hexazinone using the CDPR modeling tool, concentrations were simulated following one application of 1.5 lbs/acre on 15th January. All the chemical specific data were consistent with DPR guidance. Weather and soil data were unchanged from the standard DPR LEACHP input file. The well water concentrations were calculated at CDPR recommended aging time of 10 and 13 years for 125% and 160% irrigation schemes, respectively.

Using the standard aging times suggested in the tool documentation, all concentrations at all percentiles are below detectable levels (Table 17). The well water concentrations were also calculated at aging times of 3, 4 and 5 years to represent wells immediately adjacent to treated fields. The 95th percentile concentrations values for 4 and 5 year aging times approach the maximum concentrations observed in the monitoring program (0.274 ppb), while those for the 3 year aging time exceed the observed maximum by about 4X. The distribution of the 1000 runs for the two irrigation schemes show the impact of the sorption and degradation rate distributions in the modeling output (Figure 44 and Figure 45)

4.2 *Spatial Modeling*

A recently developed PRZM based tool was also used to evaluate the spatial distribution of potential hexazinone leaching associated with actual applications. All applications for the period of 2000 to 2008 in the Bay-Delta Estuary, Sacramento and San Joaquin Watersheds (the primary use area) were evaluated using spatially assigned soils data, weather files, and the WinPRZM Pesticide Root Zone Model (PRZM-4.51) to simulate the pesticide leaching. The PRZM model is a dynamic, compartmental model developed by the U.S. Environmental Protection Agency for use in simulating water and chemical movement in unsaturated soil systems within and below the plant root zone (Carsel et al., 1998, Focus 2000a, FOCUS 2000b). The model simulates time-varying hydrologic behavior on a daily time step, including physical processes of runoff, infiltration, erosion, and evapotranspiration. The chemical transport component of PRZM calculates pesticide uptake by plants, surface runoff, erosion, decay, vertical movement, foliar loss, dispersion and retardation. PRZM includes the ability to simulate pesticide metabolites and irrigation. Unlike the CDPR Monte Carlo methodology of variable degradation rates and sorption parameters, the simulations were conducted with a conservative set of inputs using the maximum field dissipation half-life (154 days) in the soil and the minimum sorption parameter ($K_{oc} = 38 \text{ mL/g}$). Simulations were conducted for two-year periods that include the year of application and a following year of weather and irrigation with results being presented for the combined water and mass amounts for the two-year period associated with each simulated application year.

Irrigation was enabled in the model using USEPA standard scenario irrigation rates. In comparing simulated irrigation plus rainfall in relation to evapotranspiration, it is clear the adequate water was available for leaching with over 46% of the simulations having a greater than 125% of modeled evapotranspiration and over 5% having a greater than 160% of the modeled evapotranspiration. The irrigation routines of PRZM are driven by the simulated field capacity and irrigation events are automatically added based on the set threshold and irrigation rate parameters.

The maximum total leached below the soil core (315 cm) for each PLSS cell receiving a hexazinone application according to the PUR database was used as an input to the CDPR groundwater assessment methodology and used to determine estimated groundwater concentrations. As discussed previously, travel times of 13, 10, 5, 4, and 3 years were evaluated using the equation:

$$\text{Well water concentration } (\mu\text{g/L}) = (M L * 0.5 N) / D$$

Table 18 provides a summary of well concentration for different travel times and percentiles relevant to the CDPR methodology (50th, 90th and 95th percentile). Similar to CDPR modeling, a very low percentage of simulated areas were shown to have detectable levels of hexazinone and only when short travel times were considered. For travel times of 10 and 13 years, no detectable residues are expected. For travel times of 4 or 5 years, detectable residues are only expected in 1% of the areas. For travel times of 3 years about 5 percent of the areas are expected to have detectable residues. It is important to note that the simulation results used conservative assumptions for both soil degradation (the longest observed field half-life) and sorption (lowest K_{oc}). Maps of the predicted concentrations in each simulated section for different travel times (3, 4, 5, and 10 years) are presented as Figure 46 to Figure 49 for the maximum value within each section from all years of simulations.

5.0 REFERENCES

- Bollin, E. 1992a. Field Soil Dissipation of Hexazinone Herbicide. Report No. AMR 1474-89. Harris Environmental Technologies, Inc. for E. I. du Pont de Nemours and Company, Wilmington, Delaware, U.S.A.
- Bollin, E. 1992b. Dissipation of Hexazinone in California Soil following Application of Velpar® L Herbicide. Report No. AMR 1923-91. Harris Environmental Technologies, Inc. for E. I. du Pont de Nemours and Company, Wilmington, Delaware, U.S.A.
- California Department of Pesticide Regulation (CDPR). 2011. California Pesticide Information Portal (CALPIP), Pesticide Use Reports (PUR). Accessed from <http://calpip.cdpr.ca.gov/main.cfm> (confirmed 4/8/2011)
- Carsel, R.F., J.C. Imhoff, P.R. Hummel, J.M. Cheplick, and A.S. Donigian, Jr., 1998. PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, Georgia. Available at <http://www.epa.gov/ceampubl/gwater/przm3/przm3122.htm>.
- FOCUS. 2000a. FOCUS groundwater scenarios in the EU plant protection product review process. The report of the work of the Groundwater Scenarios Workgroup of FOCUS (Forum for the Co-ordination of pesticide fate models and their Use), final version April 2000.
- FOCUS. 2000b. FOCUS PRZM Parameterisation Document. Updated version, October 2000.
- Ganapathy, Carissa. 2006. Environmental Fate of Hexazinone. Environmental Monitoring and Pest Management Branch, Department of Pesticide Regulation, Sacramento, CA. Available online at <http://www.cdpr.ca.gov/docs/emon/pubs/fatememo/hxzine.pdf> (confirmed 4/8/2011)
- Hanson, C., M. Collins, R.L. Warren, P. DeAndrea, J. Kelley, D. Murrow, C.T. Stone. 2000. A Small-Scale Prospective Groundwater Monitoring Study for Hexazinone. Report No. AMR 3202-94. Stone Environmental, Inc.,

- Montpelier, Vermont for E. I. du Pont de Nemours and Company, Wilmington, Delaware, U.S.A
- Miller, P.S., K.N. Wright, and N.J. Snyder. 2011. Surface and Groundwater Vulnerability Assessment for Hexazinone in Canada. Report No. Dupont-32113 CA. Waterborne Environmental Inc., Leesburg, Virginia, U.S.A. for E. I. du Pont de Nemours and Company, Wilmington, Delaware, U.S.A.
- Nordmark, Craig. 2011. Groundwater Monitoring Data for Hexazinone. January 10, 2011 Email from Craig Nordmark (CDPR EMB) to Aldos Barefoot (DuPont Crop Protection) transmitting monitoring data query and results as MS Excel™ data file (req_ABarefoot_hexazinone wells.xls)
- Nordmark, C. and L. Quagliaroli. 2010. Hexazinone Residues in California Ground Water-Monitoring Data Provide Evidence That Detections Result From Legal Agricultural Use. May 27, 2010 Memorandum from Nordmark and Quagliaroli to Lisa Ross, Ph.D. Environmental Program Manager I, CDPR Environmental Monitoring Branch.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for the United States. Available online at <http://soildatamart.nrcs.usda.gov> (confirmed 4/8/2011)
- Troiano, John and Murray Clayton. 2009. Modifications of the Probabilistic modeling approach to predict well water concentrations used for assessing the risk of ground water contamination by pesticides. Analysis Memo, Environmental Monitoring Branch, California Department of Pesticide Regulation, Sacramento, CA. Available at: http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/analysis_memos/probabilistic_model.pdf (verified April 04, 2011)
- USDA, NASS; United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). 2008. USDA, National Agricultural Statistics Service, 2007 California Cropland Data Layer. USDA, NASS Marketing and Information Services Office, Washington, D.C. Accessed online at <http://www.nass.usda.gov/research/Cropland/metadata/meta.htm> (confirmed 4/8/2011)
- Woodard, V. and Jose Meléndez. 2010. EFED Registration Review Problem Formulation for Hexazinone. January 12, 2010 Memorandum from USEPA-OPP EFED to USEPA-OPP SRRD. PC Code 107201/ DP Barcode 369269.

TABLE 1 SUMMARY OF HEXAZINONE DETECTIONS

County	Location ¹	Wells Sampled For Hexazinone	Hexazinone Positive Wells				Hexazinone Use (LBS) ²	
			Unique Positive Wells	Highest conc. (ppb)	First Year Detected	Last Year Sampled	Single Section	Nine Sections ³
Section Used for Legal Agricultural Use (LAU) Determination by CDPR								
Fresno	10M17S19E36	4	3	0.274	2007	2008	320	2,155
San Joaquin	39M02S06E19	3	1	0.072	2009	2009	171	3,214
San Joaquin	39M02S06E30	1	1	0.093	2009	2009	178	3,615
Sections with Reported Use								
Merced	24M09S14E23	3	1	0.11	1997	1997	347	826
San Joaquin	39M01N05E16	2	1	0.092	2008	2008	541	4,937
San Joaquin	39M02S04E22	5	1	0.096	2002	2002	625	2,288
Solano	48M06N01E23	2	1	0.126	2007	2007	1198	7,644
Solano	48M06N01W36	4	1	0.092	1995	1995	788	1,763
Stanislaus	50M04S09E19	5	1	0.27	1996	1996	7	484
Stanislaus	50M04S11E31	5	1	0.263	2004	2004	152	1,422
Stanislaus	50M06S08E26	2	1	0.062	2007	2007	80	720
Stanislaus	50M07S09E06	2	1	0.094	2007	2007	102	1,088
Section with No Reported Use, 9 Section Block had Some Use								
Fresno	10M14S21E21	3	1	0.063	2001	2006	0	14
Solano	48M06N01E05	4	1	0.094	2002	2002	0	2,650
Stanislaus	50M07S08E14	1	1	0.073	2001	2002	0	125
Section with No Reported Use, 9 Section Block had no reported Use								
Colusa	6M15N03W36	2	1	0.056	1998	1998	0	0
Fresno	10M14S22E13	3	1	0.07	2000	2006	0	0
Los Angeles	19S01S09W27	1	1	0.069	2008	2008	0	0
Detections resulted from point source contamination.								
Tulare	54M22S27E07	1	1	0.22	1994	1995	0	0
Tulare	54M22S27E18	6	3	0.24	1994	1995	0	0
Detections were determined to be transitory (Gosselin, 1997) and later due to agricultural drainage ponds (Prichard, et al., 2005)								
San Joaquin	39M02S05E23	2	1	0.11	1996	2002	216	1,130
San Joaquin	39M02S05E24	6	1	0.07	1996	2002	435	2,642

¹County, Township, range and section of the well(s). A section is approximately one square mile.²Hexazinone use totals are given for one of three periods, 1990-95, 1990-2000 and 1990-2005, based on the year of the first detection in the section. The period used was selected to represent the hexazinone use prior to the first reported hexazinone detection. Since full pesticide user reporting began in 1990, the 1990-95 bracket was used for detections prior to 1996. Rights-of-way use is reported at the county level and is not included here.³Total hexazinone use in the section where the positive well is located and the surrounding 8 sections.

TABLE 2 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 10M17S19E36

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 10M17S19E36	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90	18.9	218.6	10M17S19E36	23226	9/26/2007	0.247
Apr-90		13.5	10M17S19E36	23225	1/24/2008	0.127
Dec-90		52.9	10M17S19E36	23224	9/25/2007	0.081
Jan-91	41.5		10M17S19E36	4792	6/13/2001	0
Jan-92		159.4	10M17S19E36	4792	1/22/2008	0
Mar-92	12.0		10M17S19E25	23222	1/23/2008	0
Dec-92		70.0	10M17S19E26	23223	1/24/2008	0
Feb-93		13.0	10M17S19E35	4789	8/2/1994	0
Dec-93		35.0	10M17S19E35	4789	8/2/1994	0
Jan-94		90.6	10M17S19E35	4790	10/27/1997	0
Dec-94		40.7	10M17S19E35	4790	8/2/1994	0
Feb-95		36.0	10M17S19E35	4790	1/23/2008	0
Jan-96		27.0	10M17S19E35	4791	3/4/1993	0
Feb-97		6.4	10M17S19E35	4791	3/4/1993	0
Jan-98		55.5	10M17S20E31	4828	1/24/2008	0
Feb-98		52.5	10M17S20E31	23227	1/23/2008	0
Nov-98		37.0	16M18S19E01	23256	1/24/2008	0
Dec-98		11.7	16M18S19E01	23257	1/23/2008	0
Dec-99	17.6		16M18S20E06	23258	1/23/2008	0
Jan-00		87.1				
Dec-00	28.6	22.9				
Dec-01	29.4	37.7				
Jan-02		39.2				
Dec-02	28.6	31.0				
Jan-03		161.9				
Dec-03	21.0	34.4				
Jan-04		161.1				
Dec-04		61.5				
Jan-05	49.6	70.3				
Feb-05		2.6				
Dec-05	72.5	207.1				
Jan-06		77.0				
Feb-06		38.2				
Dec-06		160.3				
Jan-07		22.9				
Feb-07		119.4				
Dec-07	75.5	230.3				
Jan-08		30.0				
Dec-08		127.0				
Jan-09	17.0	22.0				
Dec-09		45.0				

TABLE 3 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 39M02S06E19

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 39M02S06E19	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Feb-90		103.1	39M02S06E19	See Note		0.072
Dec-90		119.2	39M02S06E19	14961	10/30/1996	0
Jan-91		50.9	39M02S06E19	14962	10/30/1996	0
Feb-91		27.5	39M02S05E13	14892	10/30/1996	0
Jan-92		33.5	39M02S05E13	14893	10/30/1996	0
Jan-93		97.0	39M02S05E13	21933	4/16/2003	0
Feb-93	24.8	81.6	39M02S05E24	14917	8/8/1996	0
Dec-94	95.4	240.1	39M02S05E24	14918	8/8/1996	0.07
Jan-95		37.8	39M02S05E24	14916	10/3/1996	0
Jan-96	19.8	250.6	39M02S05E24	14917	10/3/1996	0
Dec-96	16.5	203.3	39M02S05E24	14918	10/3/1996	0.063
Jan-97		37.5	39M02S05E24	14918	10/7/2002	0.05
Feb-97		100.5	39M02S05E24	21934	4/16/2003	0
Dec-97		358.5	39M02S05E24	21935	4/16/2003	0
Dec-98		184.2	39M02S05E24	21936	4/16/2003	0
Jan-99		60.0	39M02S05E25	14921	10/30/1996	0
Nov-99		16.5	39M02S05E25	14922	10/30/1996	0
Dec-99		154.7	39M02S05E25	14920	10/31/1996	0
Nov-00		38.6	39M02S06E18	14959	10/30/1996	0
Dec-00		202.8	39M02S06E18	14960	11/6/1996	0
Dec-01		229.7				
Jan-02		40.7				
Jan-03		67.5				
Dec-03	15.0	208.7	NOTE: Concentration in 2009 reported in May 27, 2010 memorandum but not included in groundwater database provided to DuPont.			
Dec-04		98.9				
Jan-06		44.1	Detections in neighboring section 39M02S05E24 were determined to be transitory (Gosselin, 1997) and later due to agricultural drainage ponds (Prichard, et al., 2005).			
Dec-06		114.1				
Jan-07		21.4				
Feb-07		10.0				
Dec-07		121.0				
Jan-08		19.0				
Feb-08		15.0				
Dec-08		71.0				
Dec-09		128.0				

TABLE 4 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 39M02S06E30

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 39M02S06E30	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Feb-90		60.3	39M02S06E30	See Note		0.093
Dec-90		119.2	39M02S05E24	14917	8/8/1996	0
Jan-91		50.9	39M02S05E24	14918	8/8/1996	0.07
Jan-93		60.0	39M02S05E24	14916	10/3/1996	0
Feb-93		106.4	39M02S05E24	14917	10/3/1996	0
Dec-94		235.4	39M02S05E24	14918	10/3/1996	0.063
Jan-95		37.8	39M02S05E24	14918	10/7/2002	0.05
Jan-96		227.9	39M02S05E24	21934	4/16/2003	0
Dec-96		191.4	39M02S05E24	21935	4/16/2003	0
Jan-97		37.5	39M02S05E24	21936	4/16/2003	0
Feb-97		100.5	39M02S05E25	14921	10/30/1996	0
Dec-97		358.5	39M02S05E25	14922	10/30/1996	0
Dec-98		107.3	39M02S05E25	14920	10/31/1996	0
Jan-99		60.0	39M02S06E19	14961	10/30/1996	0
Dec-99		129.3	39M02S06E19	14962	10/30/1996	0
Nov-00		38.6	39M02S06E31	14968	6/28/2001	0
Dec-00		144.0	NOTE: Concentration in 2009 reported in May 27, 2010 memorandum but not included in groundwater database provided to DuPont.			
Dec-01	71.3	158.4				
Jan-02		40.7				
Jan-03		67.5				
Dec-03	106.9	116.8	Detections in neighboring section 39M02S05E24 were determined to be transitory (Gosselin, 1997) and later due to agricultural drainage ponds (Prichard, et al., 2005).			
Dec-04		83.1				
Jan-06		30.0				
Dec-06		114.1				
Feb-07		10.0				
Dec-07		121.0				
Dec-08		71.0				
Dec-09		67.9				

TABLE 5 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 24M09S14E23

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 24M09S14E23	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90	25.2		24M09S14E23	10163	11/5/1997	0.11
Jan-91	99.9	27.5	24M09S14E23	10165	6/2/1998	0
Feb-91		11.5	24M09S14E23	10166	6/2/1998	0
Jan-92		30.1	24M09S14E14	10154	6/3/1998	0
Feb-92		29.3	24M09S14E15	10155	6/2/1998	0
Dec-92	4.7	43.8	24M09S14E22	10162	6/2/1998	0
Jan-93	13.3	29.7				
Feb-93	22.4	57.3				
Dec-93	18.1	115.6				
Jan-94	57.6	5.7				
Feb-94	12.9	15.3				
Nov-94	29.8	11.5				
Dec-94	62.7	65.1				
Jan-95		18.3				
Feb-95		10.2				
Dec-95		8.6				
Jan-96	61.6	254.2				
Feb-96		32.4				
Mar-96		17.8				
Dec-96		28.7				
Jan-97	32.1	165.0				
Mar-97		37.1				
Dec-97		173.9				
Jan-98	28.1	55.0				
Mar-98	20.8	35.9				
Dec-98	18.6	195.8				
Jan-99	23.0	14.4				
Feb-99		56.5				
Dec-99	42.3	173.5				
Jan-00	24.7					
Feb-00	26.7					
Mar-00		69.3				
Nov-00	37.4	60.9				
Dec-00	10.9	107.2				
Jan-01	23.0	7.8				
Feb-01		58.9				
Dec-01	75.3	237.5				
Jan-02	30.0	90.0				
Jan-04	25.5					
Feb-04		41.1				
Jan-06		29.0				
Dec-06	22.2	94.4				
Feb-07		55.0				
Dec-07		142.9				
Feb-09		26.2				
Dec-09		102.4				

TABLE 6 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 39M01N05E16

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 39M01N05E16	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Dec-90		264.8	39M01N05E16	23323	6/10/2008	0
Feb-92		60.3	39M01N05E16	23324	6/10/2008	0.092
Dec-92		325.2	39M01N05E15	23321	6/10/2008	0
Jan-93		13.4	39M01N05E15	23322	6/10/2008	0
Feb-93		60.8				
Dec-93		44.6				
Jan-94		149.9				
Dec-94		529.0				
Dec-95		139.5				
Jan-96	40.5	74.3				
Feb-96		23.4				
Dec-96	124.5					
Dec-97	80.9	273.9				
Jan-98		15.0				
Nov-98	55.0	192.3				
Dec-98	25.5	203.6				
Nov-99	61.9					
Dec-99	26.5	315.7				
Jan-00	70.0	96.0				
Nov-00	56.3					
Dec-00		154.7				
Nov-01		177.2				
Dec-01		63.9				
Jan-02		206.2				
Dec-02		320.1				
Dec-03		323.2				
Jan-04		247.4				
Dec-04		121.5				
Jan-06		19.5				
Dec-06	24.8	234.5				
Jan-07		47.9				
Dec-07		126.0				
Jan-08		171.0				
Jan-09		153.2				
Dec-09		179.2				

TABLE 7 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 39M02S04E22

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 39M02S04E22	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-91		100.3	39M02S04E22	21927	10/8/2002	0.096
Dec-91		51.2	39M02S04E22	21926	4/16/2003	0
Dec-92		57.2	39M02S04E22	21928	4/16/2003	0
Jan-93		100.0	39M02S04E22	21929	4/16/2003	0
Dec-94	135.0	110.8	39M02S04E22	21930	4/16/2003	0
Feb-95		4.5	39M02S04E15	21925	4/16/2003	0
Nov-95		99.5				
Jan-96	196.3	127.7				
Dec-96	230.9	78.5				
Jan-97		91.6				
Dec-97	62.4	144.8				
Jan-98		22.5				
Nov-98		60.0				
Dec-98		68.7				
Jan-99		50.9				
Nov-99		251.9				
Dec-99		208.8				
Dec-00		34.4				
Jan-01		4.5				
Dec-01		22.9				
Jan-03		41.7				
Dec-03		15.0				
Jan-04		96.8				
Dec-04		59.5				
Jan-08		28.0				
Feb-08		42.0				
Dec-09		105.5				

TABLE 8 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 48M06N01E23

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 48M06N01E23	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90	77.4	543.6	48M06N01E23	17594	10/23/2002	0
Jan-92	77.4	491.2	48M06N01E23	23356	2/6/2007	0.126
Jan-93		257.2	48M06N01E13	21963	10/22/2002	0
Feb-93	38.7	329.6	48M06N01E14	23352	2/6/2007	0
Jan-94	89.3	761.7	48M06N01E14	23353	2/6/2007	0
Jan-95	255.5	895.8	48M06N01E22	21964	10/22/2002	0
Feb-95	33.7	214.3	48M06N01E22	23355	1/26/2007	0
Jan-96		154.9				
Jan-97		93.0				
Dec-97		25.4				
Feb-98		220.9				
Jan-99	50.9	629.8				
Dec-99		95.1				
Jan-00	185.3	435.8				
Dec-00		82.5				
Jan-01	124.2	223.4				
Dec-01		60.0				
Jan-02	159.7	217.6				
Jan-03	60.6	97.7				
Feb-03		187.8				
Jan-04		235.5				
Feb-05	45.4	193.5				
Jan-06		15.0				
Feb-06		98.9				
Dec-06	91.6					
Feb-08	76.0	103.0				
Dec-08	76.0					
Jan-09		151.2				

TABLE 9 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 48M06N01W36

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 48M06N01W36	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90		143.5	48M06N01W36	17621	3/21/1995	0
Jan-91	367.5	188.7	48M06N01W36	17622	3/21/1995	0
Jan-92	249.4	206.0	48M06N01W36	17624	3/21/1995	0
Feb-92		76.3	48M06N01W36	17625	3/21/1995	0
Jan-93	105.9		48M06N01W36	17625	3/21/1995	0.064
Feb-93		76.9	48M06N01W36	17625	3/21/1995	0.092
Jan-94	360.3	155.7	48M06N01W36	23362	1/26/2007	0
Dec-94		47.8	48M06N01W36	23363	2/1/2007	0
Feb-95		79.4	48M06N01W36	23364	4/10/2008	0
Jan-96	149.9	259.4	48M06N01E31	17597	3/23/1995	0
Feb-96		43.3	48M06N01E31	17598	3/23/1995	0
Dec-96		127.9	48M06N01E31	23360	1/26/2007	0
Jan-98		218.5	48M06N01E31	23361	1/26/2007	0
Jan-99		115.3	48M05N01W02	23348	4/10/2008	0
Feb-00		96.1	48M05N01W02	23349	4/10/2008	0
Dec-00		75.6				
Jan-01		105.7				
Jan-02		252.7				
Jan-03		27.5				
Dec-03		128.6				
Jan-04		55.0				
Dec-04		186.4				
Feb-05	81.4					
Dec-05		157.5				
Dec-06		113.0				
Jan-08		106.0				
Dec-08	35.0	293.0				
Dec-09	103.0	422.9				

TABLE 10 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 50M04S09E19

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 50M04S09E19	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90		31.6	50M04S09E19	18547	8/6/1996	0.22
Feb-90		10.2	50M04S09E19	18547	8/6/1996	0.27
Jan-91		12.2	50M04S09E19	18546	11/21/1996	0
Feb-91		15.8	50M04S09E19	18548	11/21/1996	0
Jan-92		49.9	50M04S09E19	18549	11/21/1996	0
Feb-92		10.7	50M04S09E19	18550	11/21/1996	0
Dec-92		11.2	50M04S09E18	18545	11/21/1996	0
Jan-93		50.5	50M04S09E30	18596	6/23/1998	0
Feb-93		20.0				
Dec-93		88.0				
Jan-94	7.5	61.0				
Dec-94		59.7				
Dec-95		56.4				
Jan-96		69.8				
Jan-97	25.4	75.3				
Feb-97		14.8				
Dec-97		158.9				
Jan-98		42.0				
Feb-98		8.0				
Dec-98		9.0				
Jan-99		132.0				
Dec-99		37.5				
Jan-00		39.2				
Dec-00		45.7				
Jan-01		35.0				
Jan-02		74.7				
Jan-03		75.2				
Jan-04	21.3	31.7				
Feb-04		53.7				
Dec-04		85.7				
Jan-05		9.2				
Feb-05		1.2				
Nov-05		32.8				
Dec-05		31.3				
Jan-06	4.1	35.1				
Jan-07		45.1				
Feb-07		20.4				
Jan-08		16.0				
Feb-08		19.0				

TABLE 11 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 50M04S11E31

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 50M04S11E31	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90		34.2	50M04S11E31	18698	8/3/1994	0
Dec-90	12.2	164.1	50M04S11E31	18701	8/3/1994	0
Jan-91		20.4	50M04S11E31	18700	10/3/2001	0
Dec-91	20.4	137.1	50M04S11E31	18700	10/3/2001	0
Jan-92		20.4	50M04S11E31	18699	10/17/2001	0
Dec-92		100.3	50M04S11E31	18698	8/9/2004	0.263
Jan-93		23.5	50M04S11E31	18700	8/9/2004	0
Dec-93	19.5	201.2	50M04S11E31	22314	8/9/2004	0
Feb-94		18.2	50M04S11E29	22311	8/10/2004	0
Dec-94	23.0	295.9	50M05S10E01	18776	9/22/1993	0
Jan-95		16.5	50M05S10E01	18776	9/22/1993	0
Dec-95	14.3	170.2	50M05S10E01	18777	8/3/1994	0
Jan-96	20.0	18.2	50M05S10E01	18777	8/3/1994	0
Dec-96	20.4		50M05S10E01	18778	8/3/1994	0
Dec-98	22.5	9.0	50M05S11E06	18847	4/19/1995	0
Dec-00		40.2	50M04S11E29	22312	8/9/2004	0
Dec-01	10.0	10.2	50M04S11E30	22313	8/10/2004	0
Jan-02		9.2				
Dec-02	5.6	198.4				
Jan-03		10.2				
Dec-03		9.0				
Jan-04		8.5				
Dec-05		151.2				
Dec-06		24.4				
Dec-07		344.1				
Dec-08		318.0				

TABLE 12 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 50M06S08E26

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 50M06S08E26	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Dec-90		103.3	50M06S08E26	18891	8/14/2001	0
Jan-92		94.6	50M06S08E26	23390	3/14/2007	0
Dec-92		52.9	50M06S08E26	23391	3/14/2007	0.062
Jan-93		84.0	50M06S08E26	23392	3/14/2007	0
Dec-93		58.0	50M06S08E35	18897	4/19/1995	0
Jan-94	40.0	47.5	50M06S08E36	18901	6/12/2001	0
Dec-94		131.3	50M06S08E23	18886	6/26/2001	0
Jan-95	40.0	47.5	50M06S08E35	18898	6/27/2001	0
Jan-97		20.0	50M06S08E25	18889	8/13/2001	0
Dec-06	20.0	9.0	50M06S08E36	18900	8/14/2001	0
Feb-08	15.0	7.0	50M06S08E25	23389	3/13/2007	0
Jan-09		7.2	50M06S08E22	23388	3/28/2007	0
Feb-09	5.0	6.0	50M06S08E25	23389	7/20/2009	0

TABLE 13 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 50M07S09E06

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 50M07S09E06	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Dec-90		47.3	50M07S09E06	18930	8/14/2001	0
Jan-91		81.4	50M07S09E06	18931	8/14/2001	0
Nov-91		50.9	50M07S09E06	18930	3/13/2007	0.094
Feb-92		20.4	50M07S08E12	18917	6/11/2001	0
Dec-92		76.3	50M06S08E36	18901	6/12/2001	0
Dec-93		46.0	50M06S09E31	18911	6/14/2001	0
Dec-94		189.3	50M06S08E36	18900	8/14/2001	0
Dec-98	30.0	58.0	50M07S09E07	18932	8/14/2001	0
Dec-99		123.0	50M07S08E12	18917	4/8/2002	0
Dec-00		226.4	50M06S09E31	23393	3/13/2007	0
Jan-04		58.0	50M07S08E01	23394	3/13/2007	0
Dec-04		9.7				
Dec-05	71.8					
Jan-06		42.2				
Jan-08		53.0				

TABLE 14 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 10M14S21E21

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 10M14S21E21	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90		13.5	10M14S21E21	2771	3/23/1993	0
			10M14S21E21	2768	7/6/1994	0
			10M14S21E21	2768	7/6/1994	0
			10M14S21E21	2766	8/4/1999	0
			10M14S21E21	2766	3/14/2000	0
			10M14S21E21	2766	11/8/2000	0
			10M14S21E21	2766	3/21/2001	0.05
			10M14S21E21	2766	10/24/2001	0.063
			10M14S21E21	2766	4/1/2002	0
			10M14S21E21	2766	10/28/2002	0.062
			10M14S21E21	2766	5/6/2003	0
			10M14S21E21	2766	5/25/2004	0
			10M14S21E21	2766	6/27/2005	0
			10M14S21E21	2766	6/14/2006	0
			10M14S21E21	2766	5/9/2007	0
			10M14S21E21	2766	5/13/2008	0
			10M14S21E21	2766	3/16/2009	0
			10M14S21E21	2766	3/2/2010	0
			10M14S21E16	2722	8/4/1999	0
			10M14S21E16	2722	3/15/2000	0
			10M14S21E16	2722	11/8/2000	0
			10M14S21E16	2722	3/21/2001	0
			10M14S21E16	2722	10/24/2001	0
			10M14S21E16	2722	4/1/2002	0
			10M14S21E16	2722	10/23/2002	0
			10M14S21E16	2722	5/6/2003	0
			10M14S21E16	2722	5/25/2004	0
			10M14S21E16	2715	11/2/2004	0
			10M14S21E29	2819	11/3/2004	0
			10M14S21E16	2722	6/27/2005	0
			10M14S21E16	2722	6/14/2006	0
			10M14S21E16	2722	5/9/2007	0
			10M14S21E16	2722	5/13/2008	0
			10M14S21E16	2722	3/16/2009	0
			10M14S21E16	2722	3/2/2010	0

TABLE 15 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 48M06N01E05

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 48M06N01E05	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-90		301.6	48M06N01E05	17577	4/3/2002	0.094
Jan-91		127.0	48M06N01E05	21960	11/5/2002	0
Jan-92		393.7	48M06N01E05	21961	11/5/2002	0
Dec-92		38.2	48M06N01E05	21962	11/5/2002	0
Jan-93		314.2	48M06N01E08	17581	4/10/2001	0
Feb-93		158.8	48M06N01E06	17579	4/3/2002	0
Dec-93		88.6	48M06N01E07	17580	4/3/2002	0
Jan-94		243.3	48M06N01E08	17581	4/3/2002	0
Jan-96		230.0	48M06N01E08	17582	4/3/2002	0
Dec-96		251.9	48M07N01E32	21966	10/23/2002	0
Dec-97		283.9	48M07N01E33	21967	11/5/2002	0
Dec-98		82.4				
Dec-99		82.5				
Dec-00		54.5				
Dec-01	17.9	212.7				
Jan-03		22.4				
Feb-03		22.3				
Jan-04		43.8				
Feb-04	34.8	96.4				
Dec-04		3.1				
Feb-05		172.0				
Dec-05		42.8				
Jan-06	34.4	49.2				
Jan-07		173.7				
Jan-08		17.0				
Feb-08		188.0				
Feb-09		164.5				
Dec-09	38.7					

TABLE 16 HEXAZINONE USE AND MONITORING SUMMARY IN AND AROUND COMTRS 50M07S08E14

Month and Year	Reported Hexazinone Use (pounds)		Groundwater Monitoring Data			
	Sum of 50M07S08E14	Sum of Adjacent COMTRS	COMTRS	WELL ID	Sample Date	Hexazinone (ppb)
Jan-91		40.7	50M07S08E14	18925	8/15/2001	0.06
Dec-92		46.8	50M07S08E14	18925	4/8/2002	0.073
Feb-93		37.0	50M07S08E13	18918	10/29/1992	0
Feb-08		17.0	50M07S08E13	18922	10/29/1992	0
			50M07S08E12	18917	6/11/2001	0
			50M07S08E12	18917	4/8/2002	0
			50M07S08E13	18919	4/8/2002	0
			50M07S08E13	18920	4/8/2002	0
			50M07S08E13	18923	4/8/2002	0

TABLE 17 RESULTS OF LEACHP MODELING ASSESSMENT

Application rate	Irrigation amount	Aging time (years)	Longest half-life (days)	Cumulative percentile (µg/L)		
				50 th	90 th	95 th
1.5 lb/acre	125%	10	154	0.00	0.00	0.00
1.5 lb/acre	125%	5	154	0.01	0.03	0.03
1.5 lb/acre	125%	4	154	0.07	0.14	0.16
1.5 lb/acre	125%	3	154	0.38	0.73	0.80
1.5 lb/acre	160%	13	154	0.00	0.00	0.00
1.5 lb/acre	160%	5	154	0.03	0.04	0.05
1.5 lb/acre	160%	4	154	0.14	0.22	0.23
1.5 lb/acre	160%	3	154	0.74	1.14	1.21

TABLE 18 RESULTS OF PRZM SPATIAL MODELING ASSESSMENT

Aging time (years)	Longest half-life (days)	Cumulative percentile (µg/L) of all Simulations		
		50 th	90 th	95 th
13	154	0.000	0.000	0.000
10	154	0.000	0.000	0.000
5	154	0.000	0.000	0.003
4	154	0.000	0.000	0.015
3	154	0.000	0.002	0.075

FIGURE 1 ANNUAL HEXAZINONE USE SUMMARY BY COUNTY

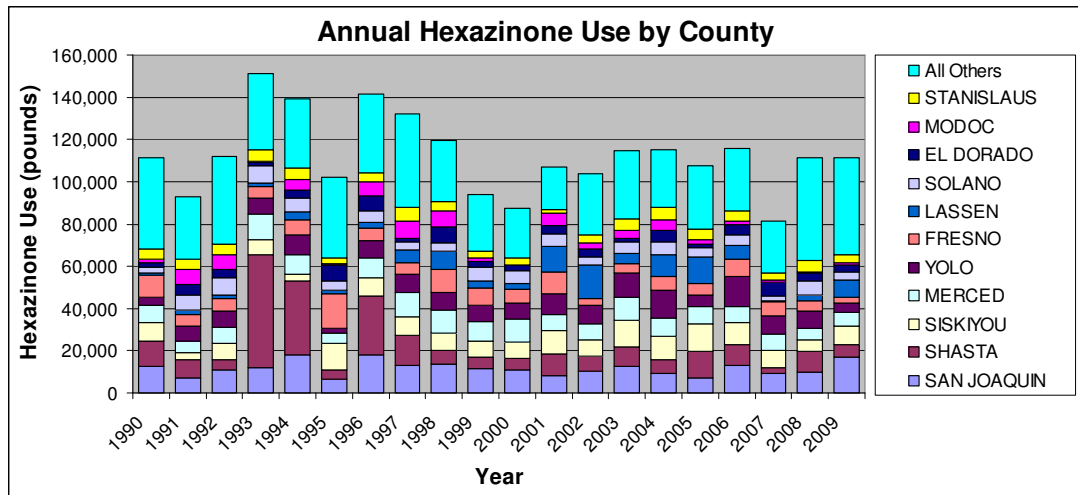


FIGURE 2 CALIFORNIA TOTAL ANNUAL HEXAZINONE USE

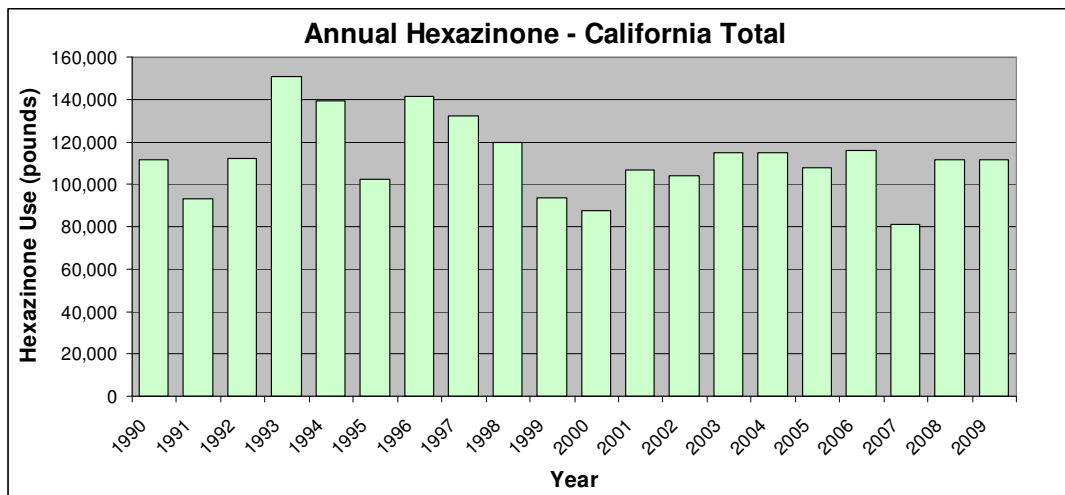


FIGURE 3 CALIFORNIA TOTAL HEXAZINONE USE ON ALFALFA

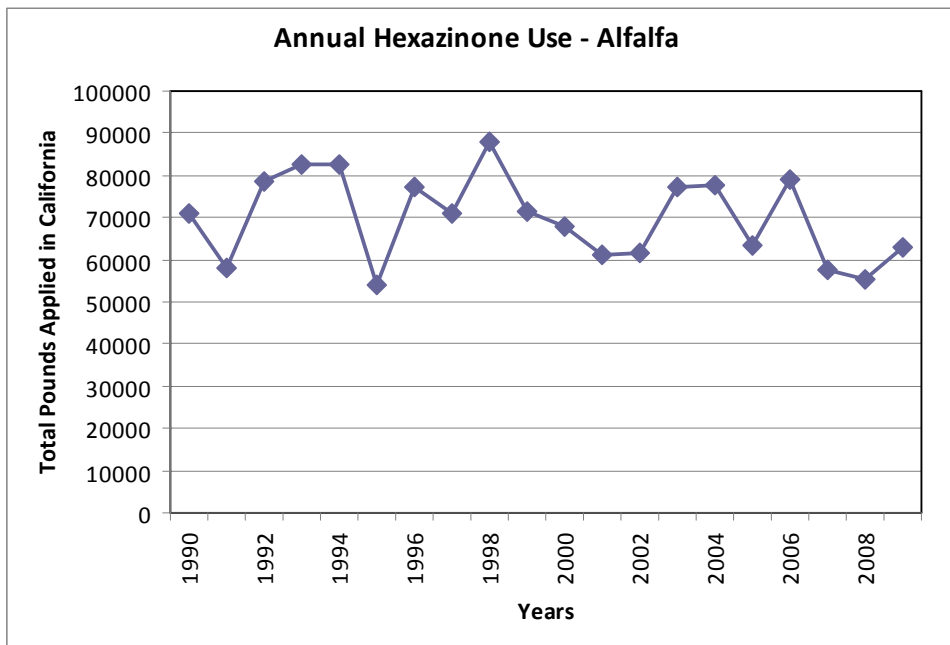


FIGURE 4 AVERAGE HEXAZINONE USE RATE ON ALFALFA (TOTAL USE PER ACRE TREATED)

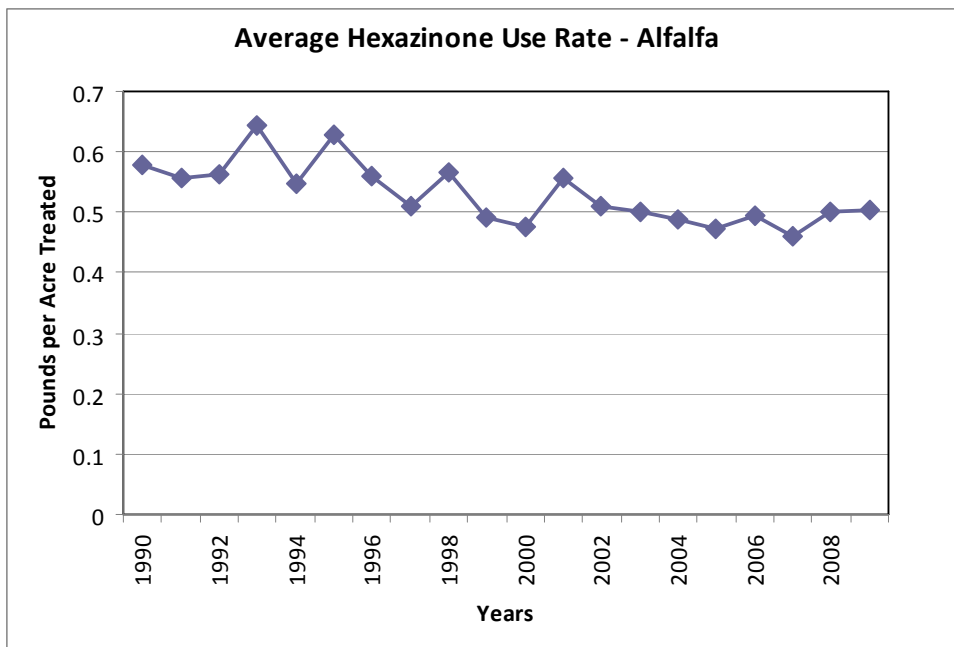


FIGURE 5 **GROUNDWATER WELLS IN THE US; MAXIMUM RESIDUE LEVELS 1988 TO PRESENT**

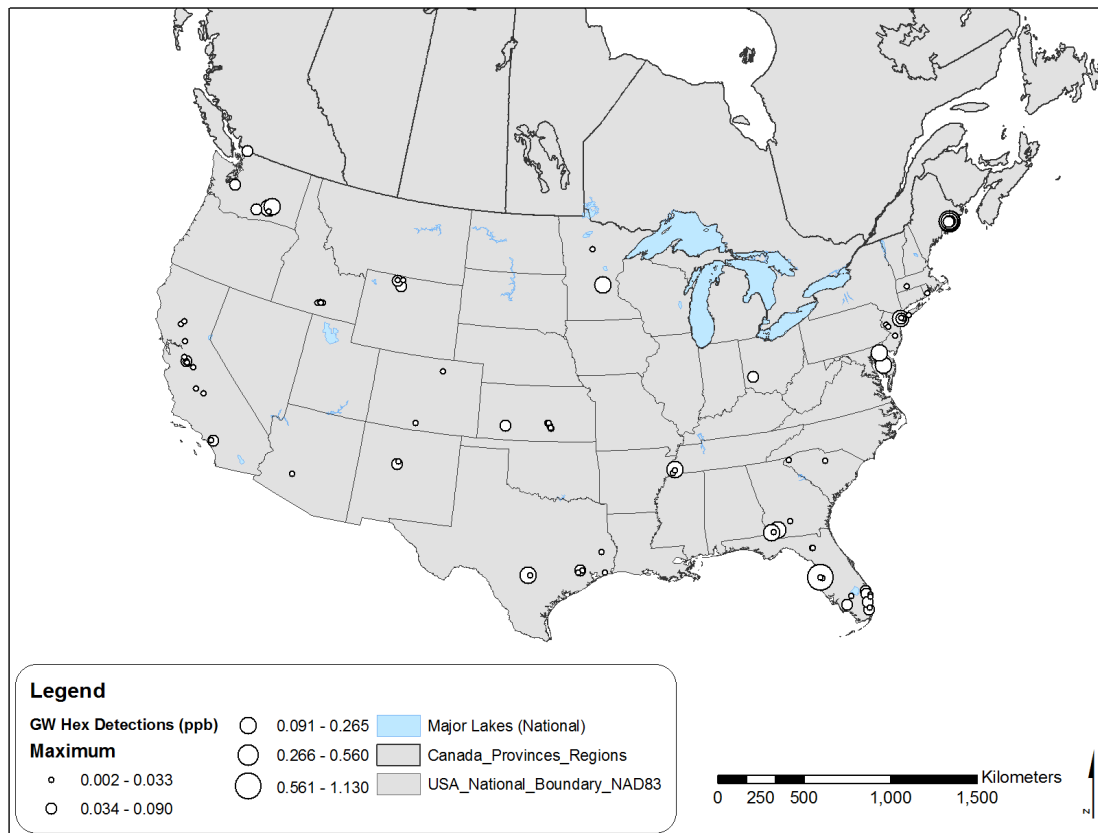
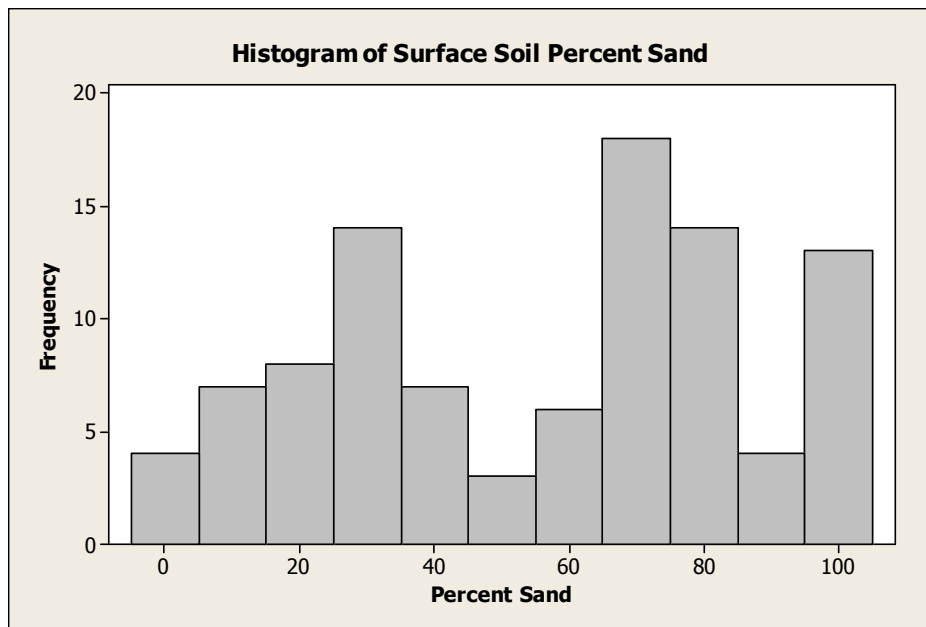


FIGURE 6 **INTERSECTED GROUNDWATER WELLS WITH DETECTIONS WITH
US SSURGO FIELD-SCALE SOIL DATA FOR PERCENT SAND**



**FIGURE 7 HEXAZINONE GROUNDWATER SAMPLE LOCATIONS AND
REPORTED USAGE**

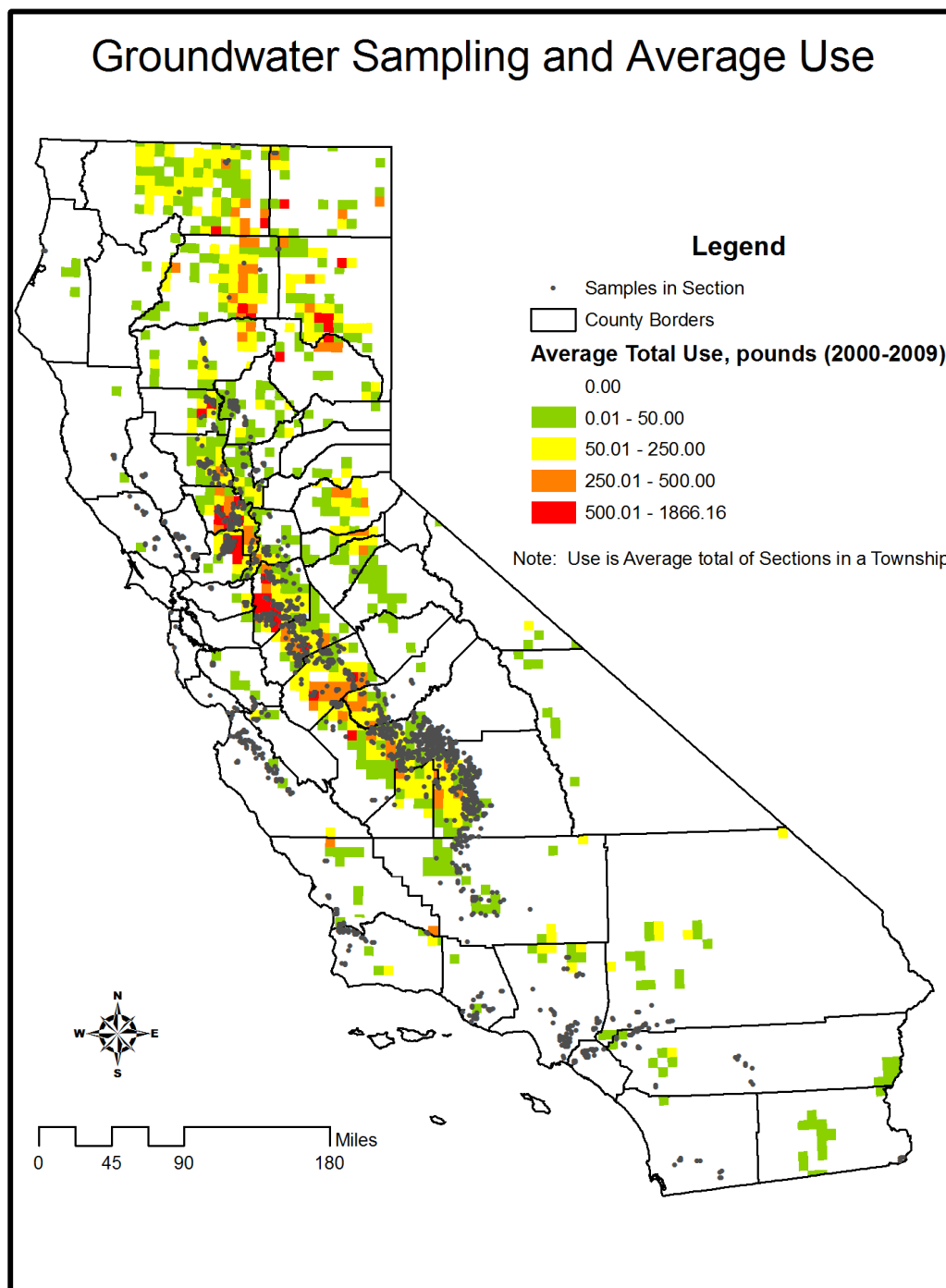


FIGURE 8 HEXAZINONE GROUNDWATER DETECTIONS AND SAMPLES AND REPORTED USAGE

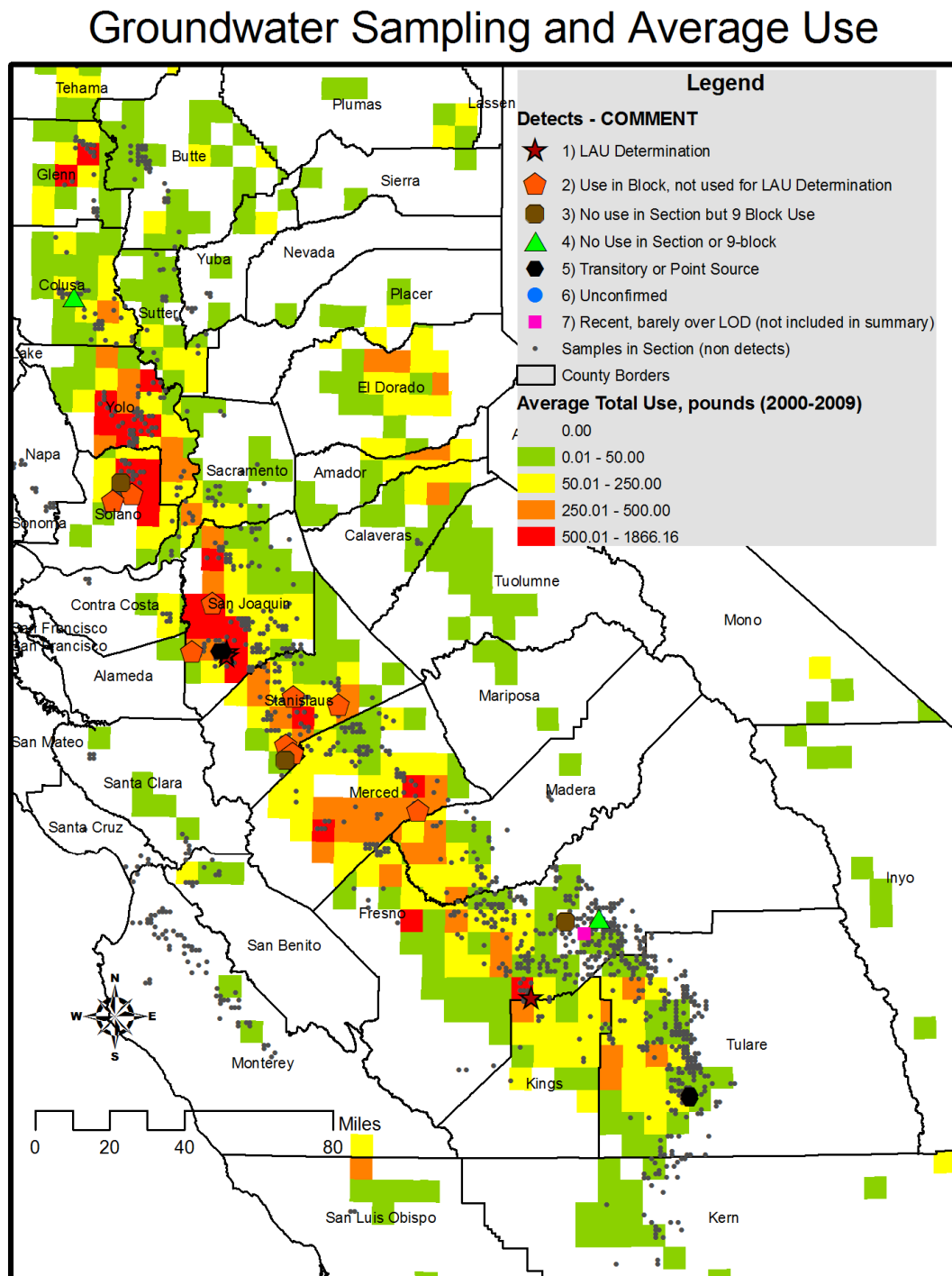


FIGURE 9 **MONTHLY USE AND MONITORING RESULTS IN AND AROUND**
LOCATION COMTRS 10M17S19E36

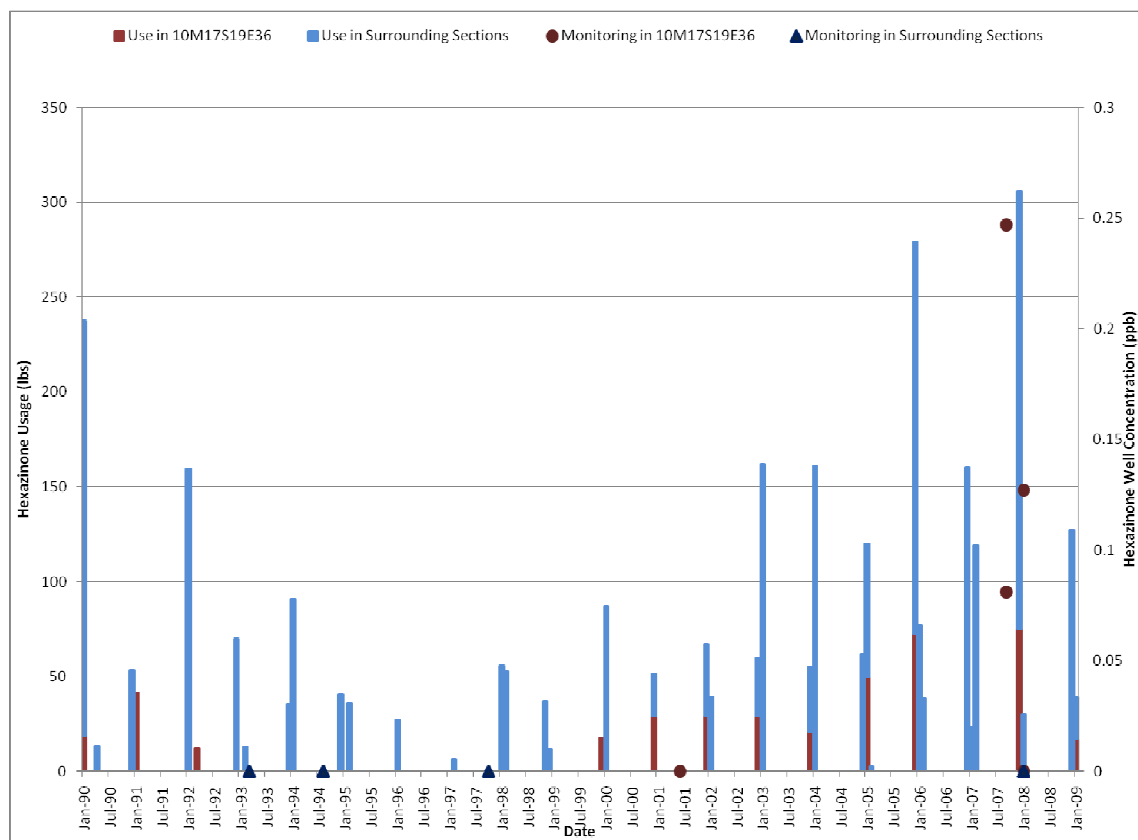
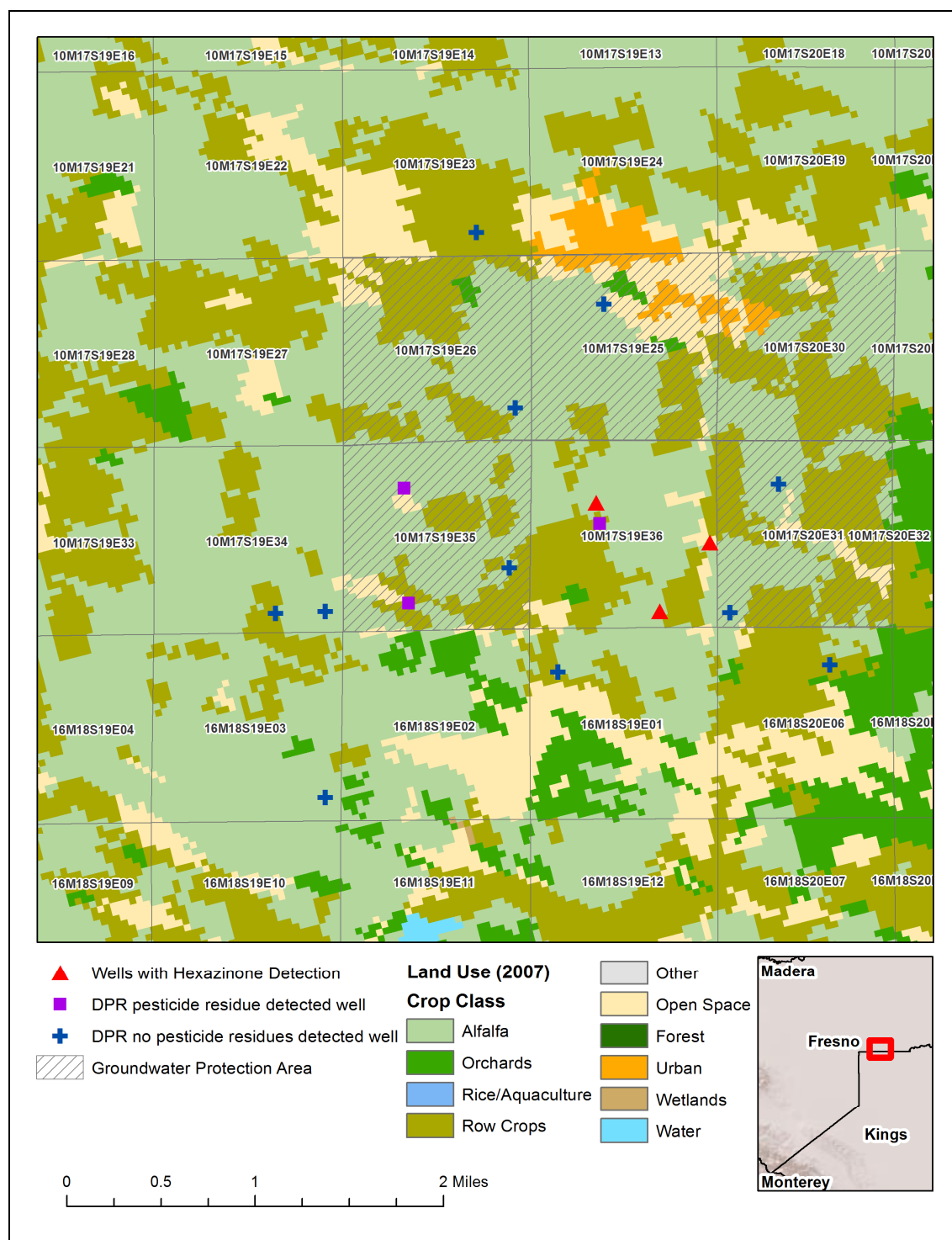
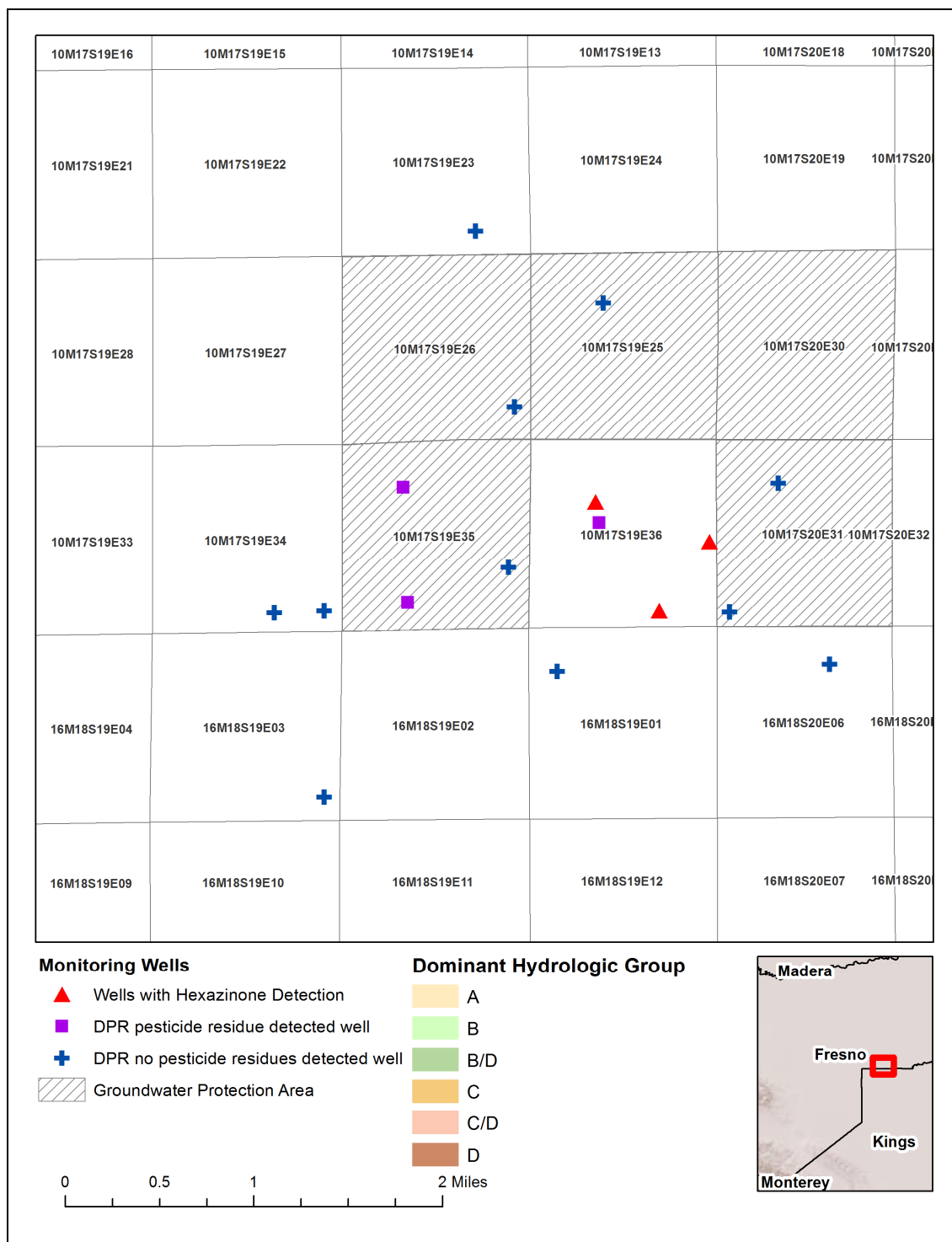


FIGURE 10 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 10M17S19E36



**FIGURE 11 HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS
AROUND COMTRS 10M17S19E36**



Note: SSURGO is not available for this area of California

FIGURE 12 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 39M02S06E19

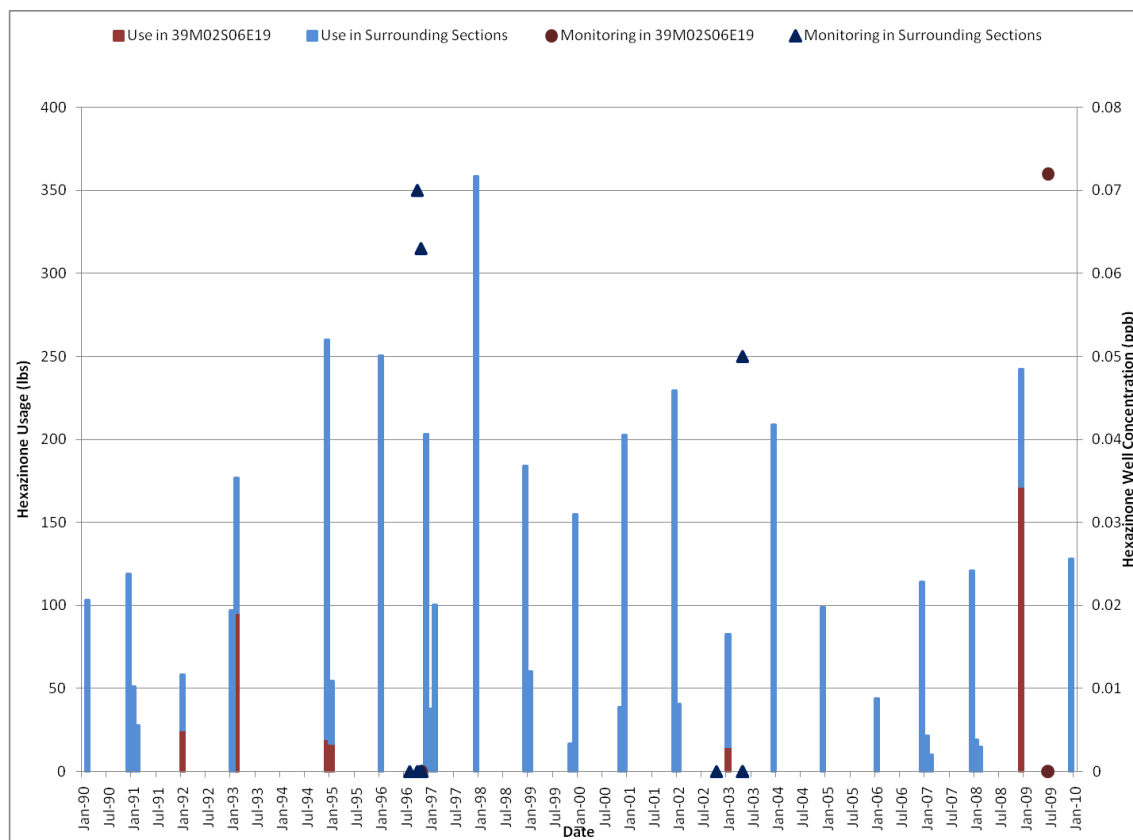


FIGURE 13 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 39M02S06E30

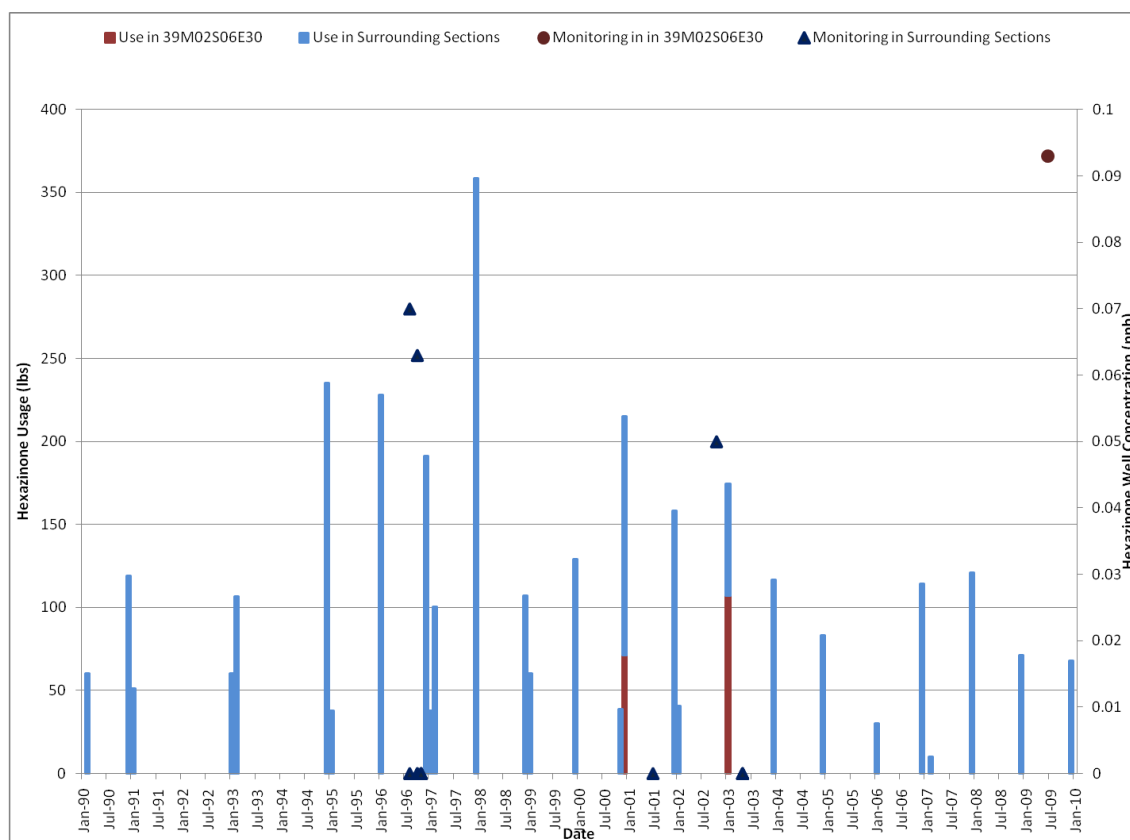


FIGURE 14 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 39M02S06E19 AND 39M02S06E30

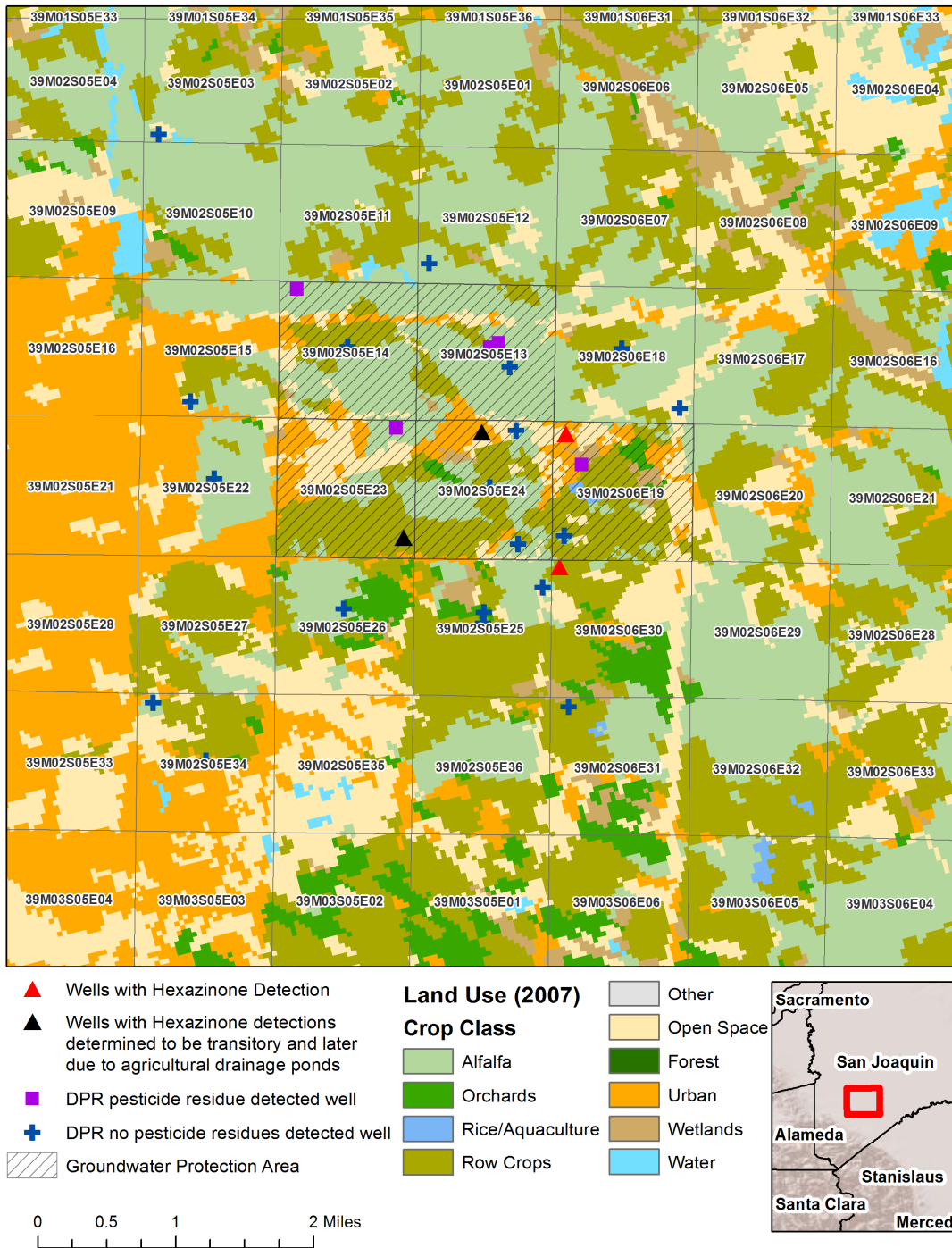


FIGURE 15 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 39M02S06E19 AND 39M02S06E30

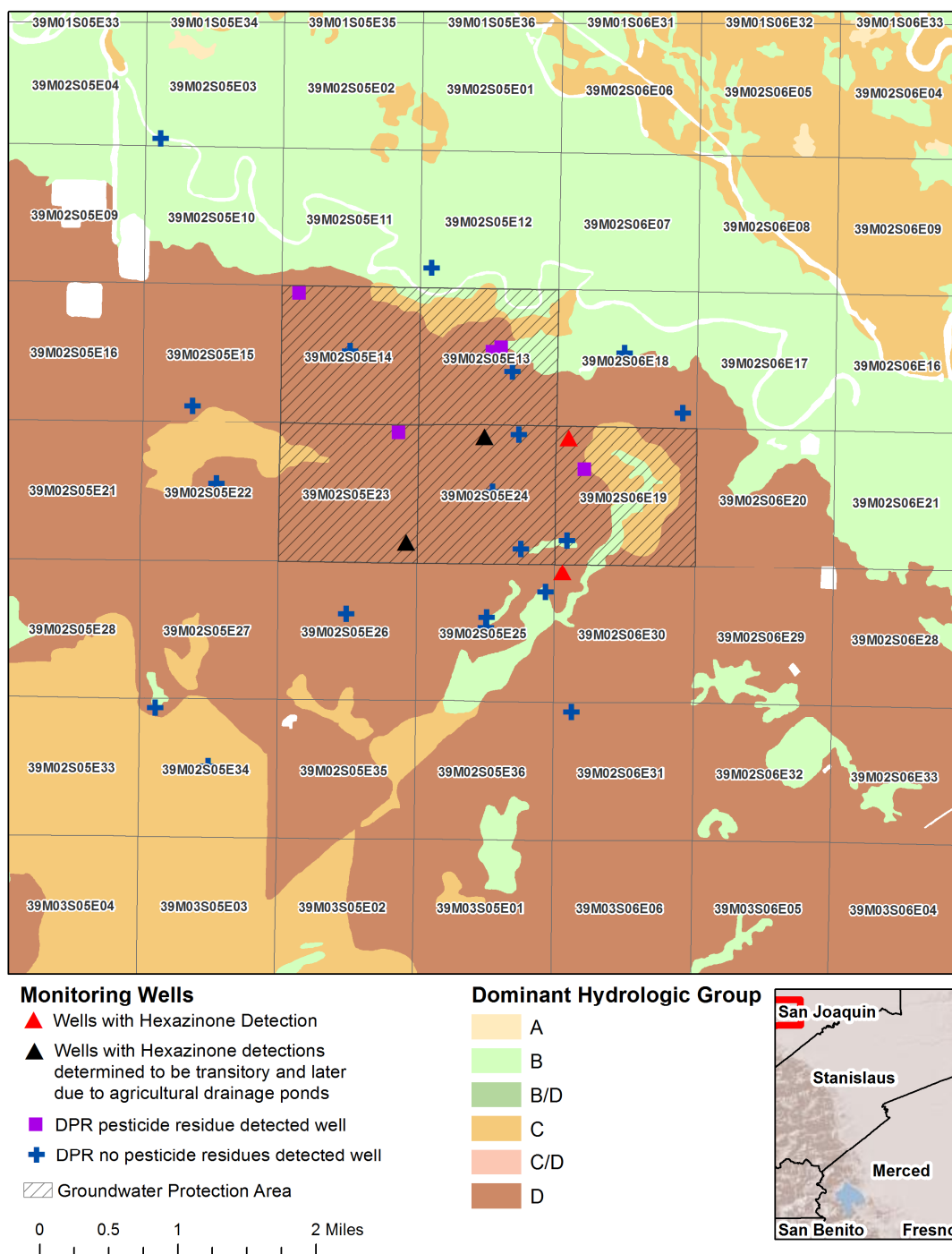


FIGURE 16 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 24M09S14E23

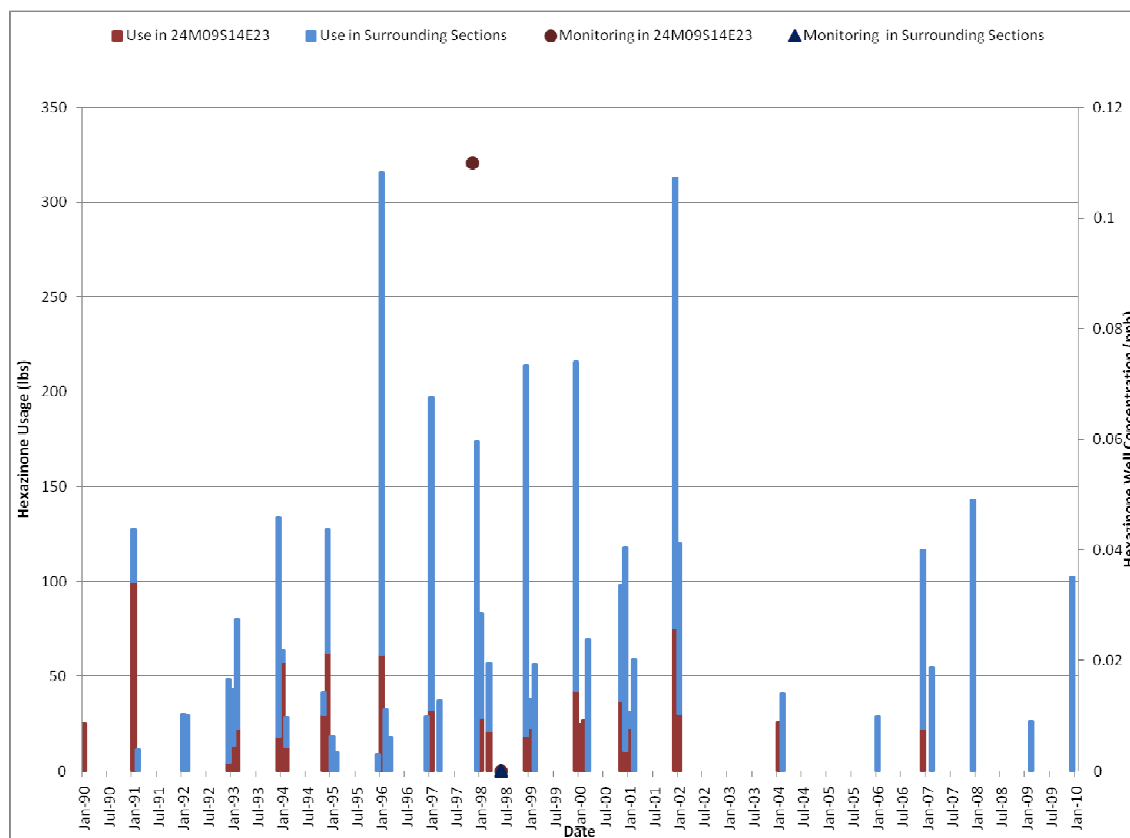


FIGURE 17 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 24M09S14E23

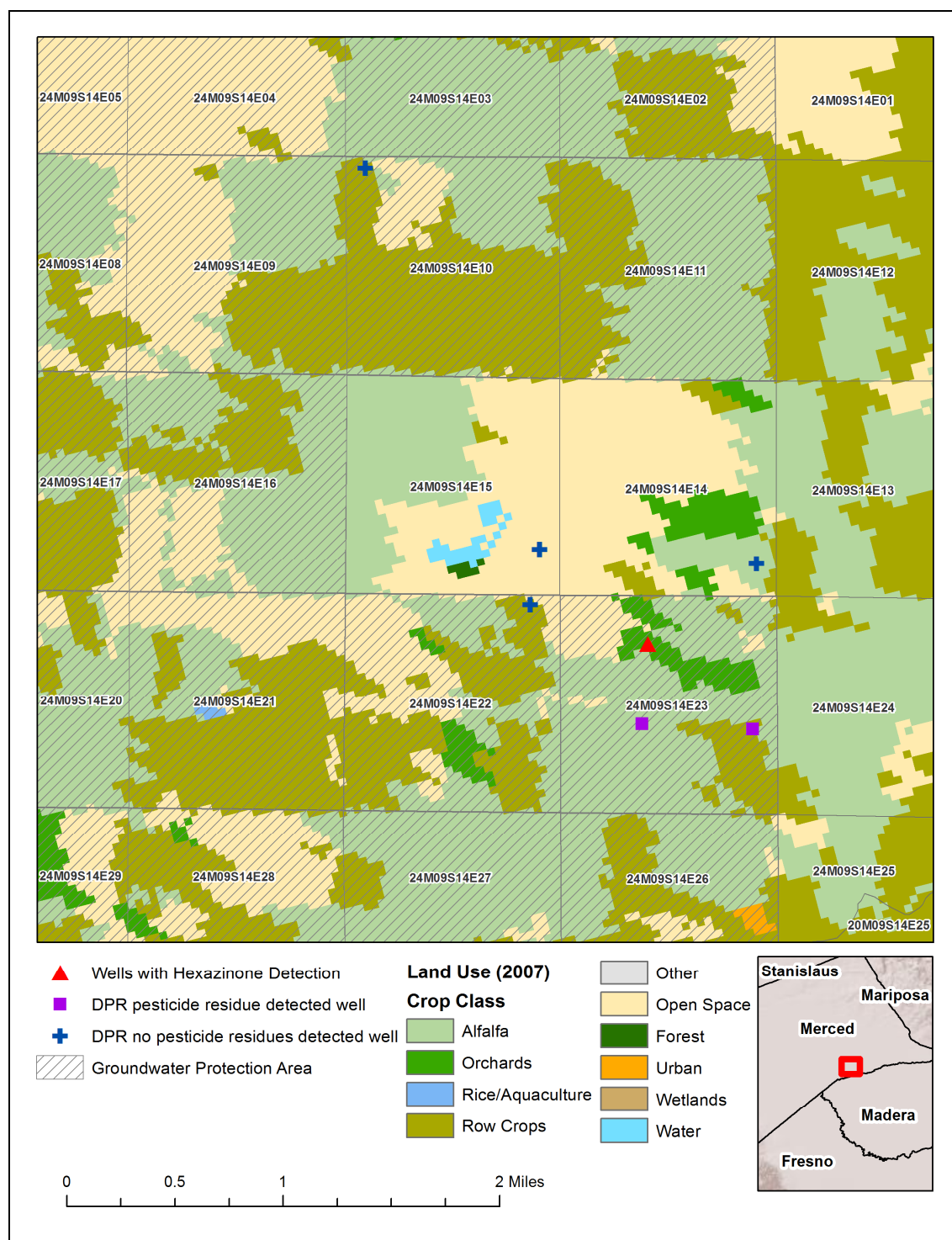


FIGURE 18 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 24M09S14E23

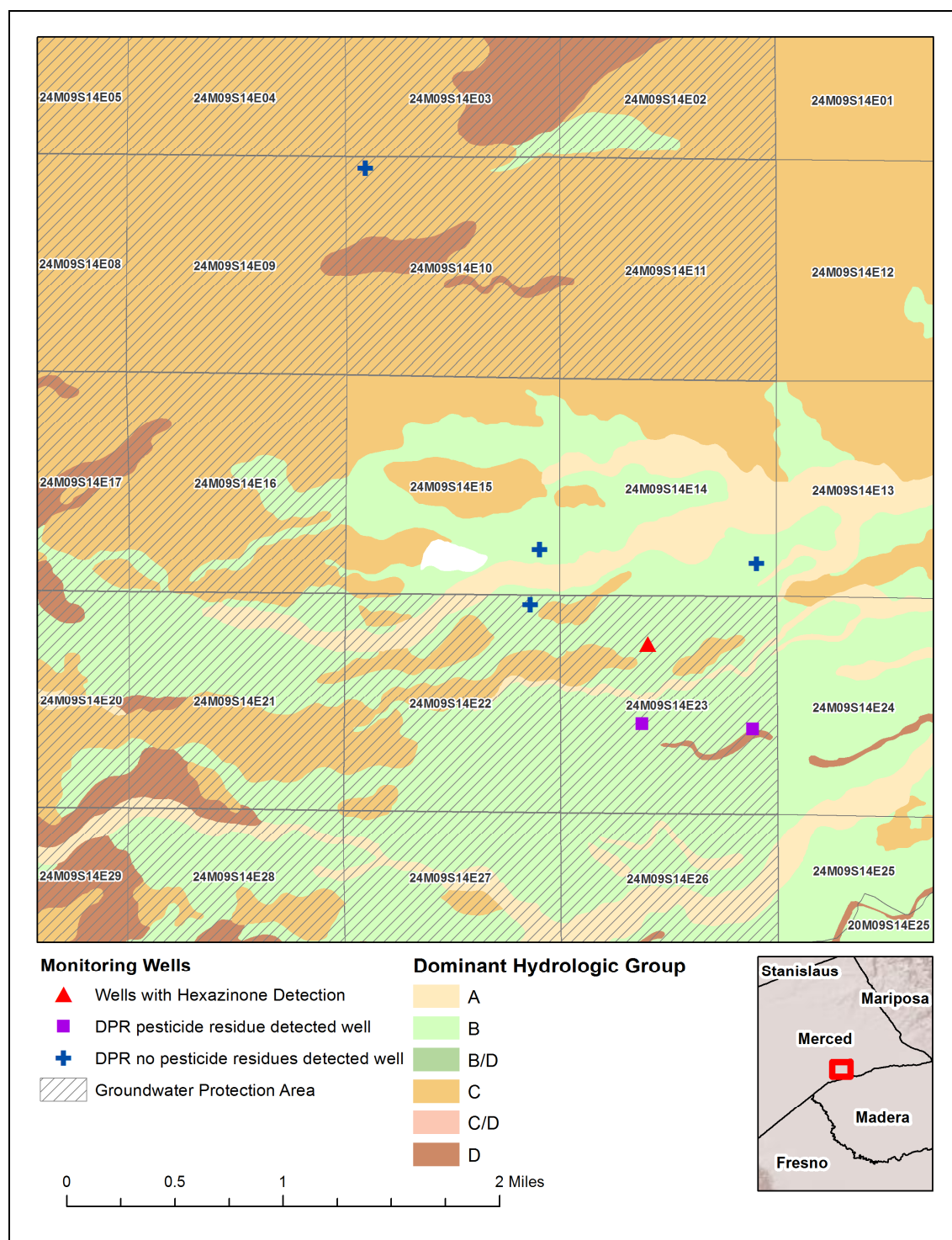


FIGURE 19 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 39M01N05E16

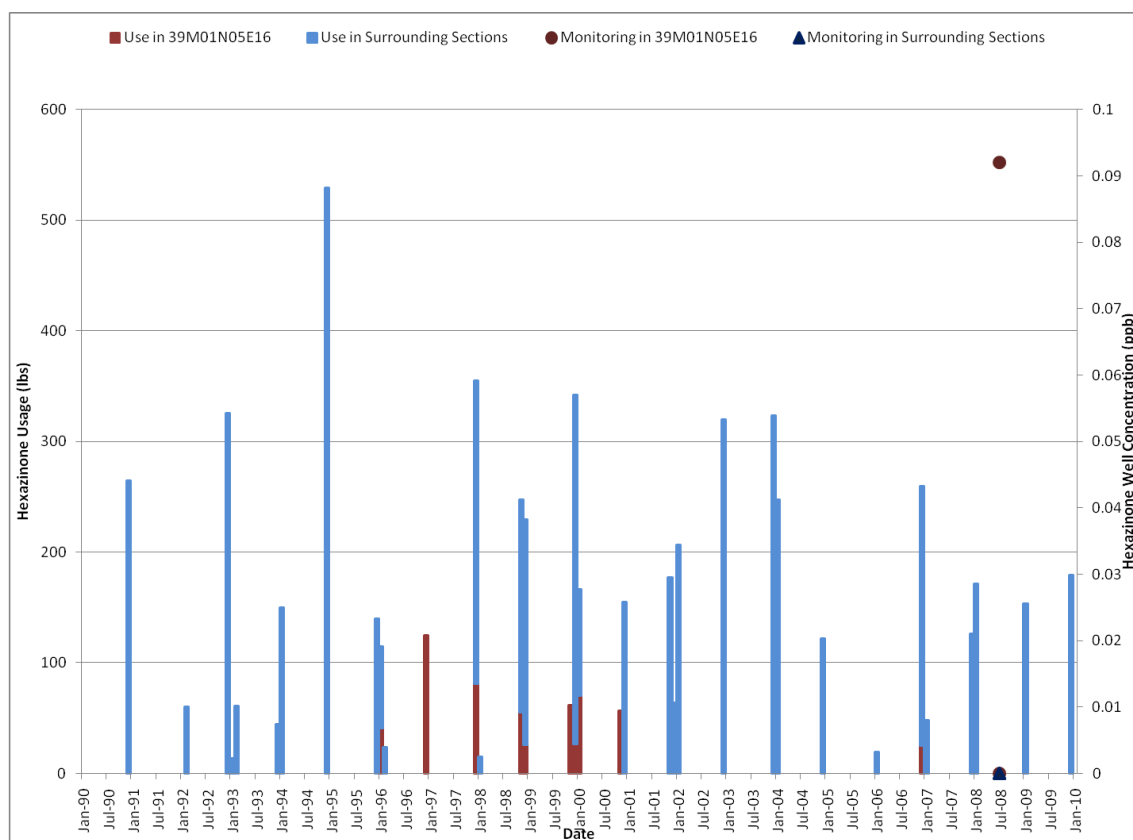


FIGURE 20 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 39M01N05E16

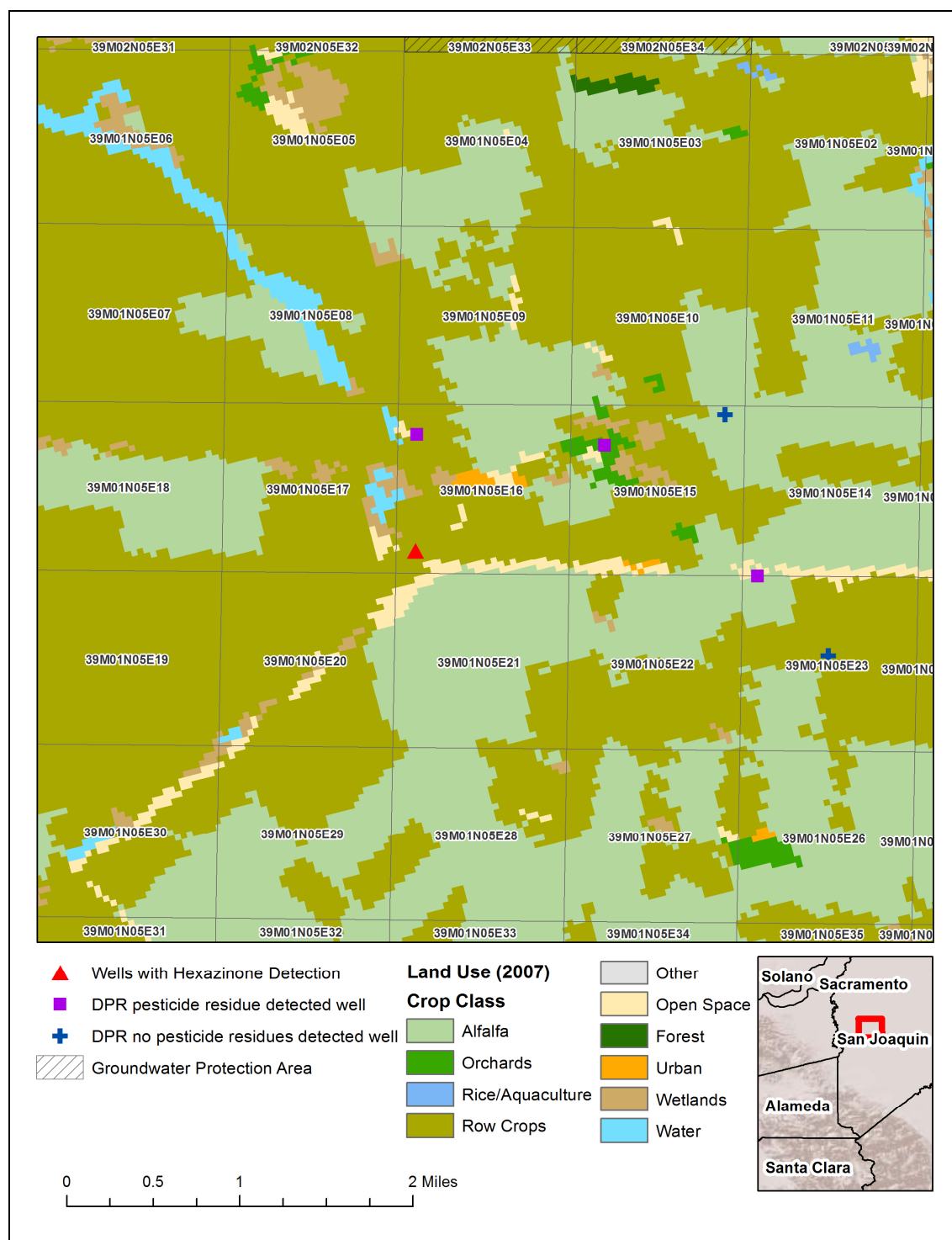


FIGURE 21 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 39M01N05E16

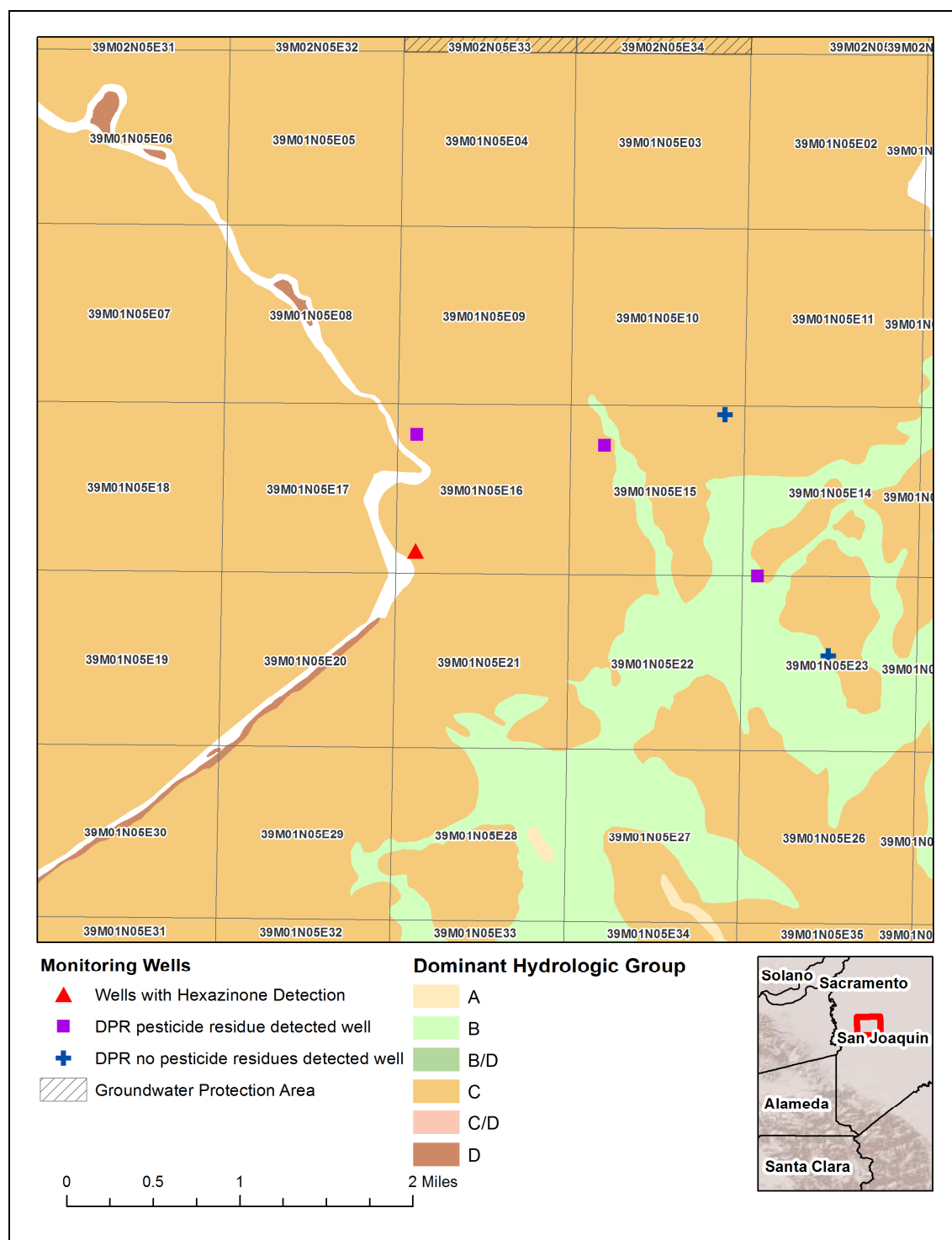


FIGURE 22 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 39M02S04E22

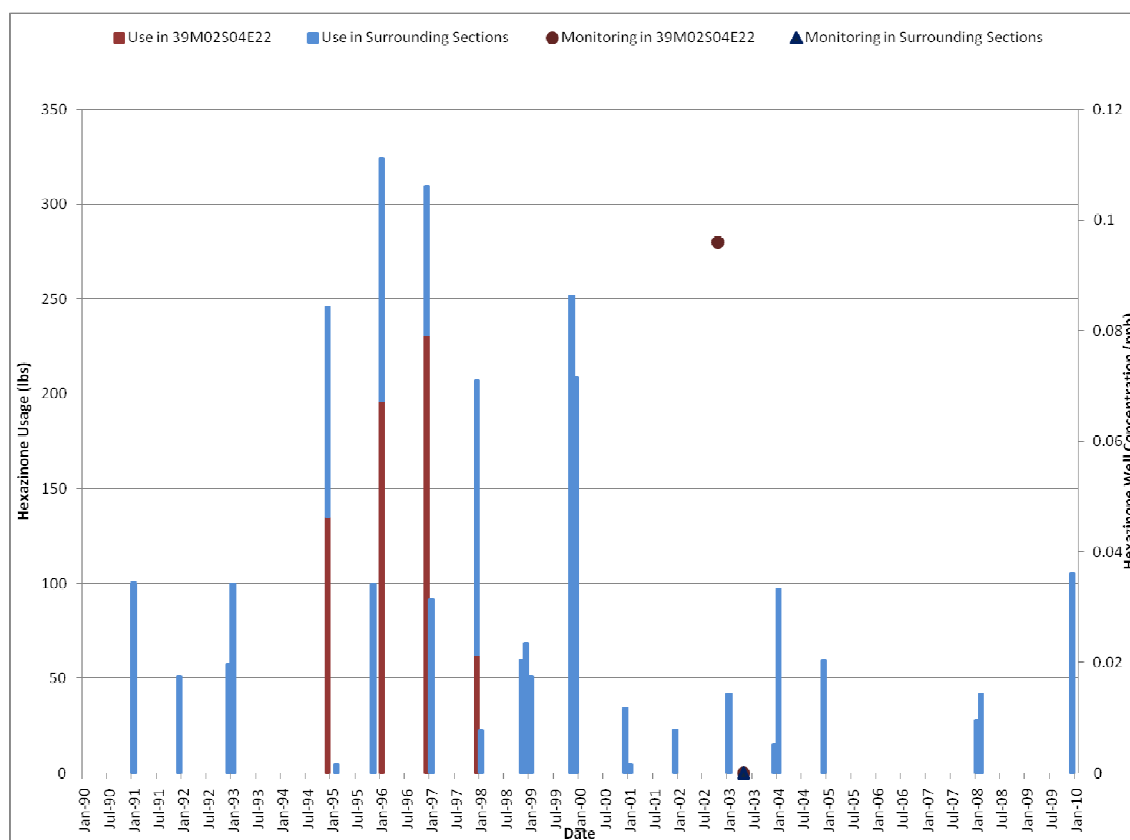


FIGURE 23 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 39M02S04E22

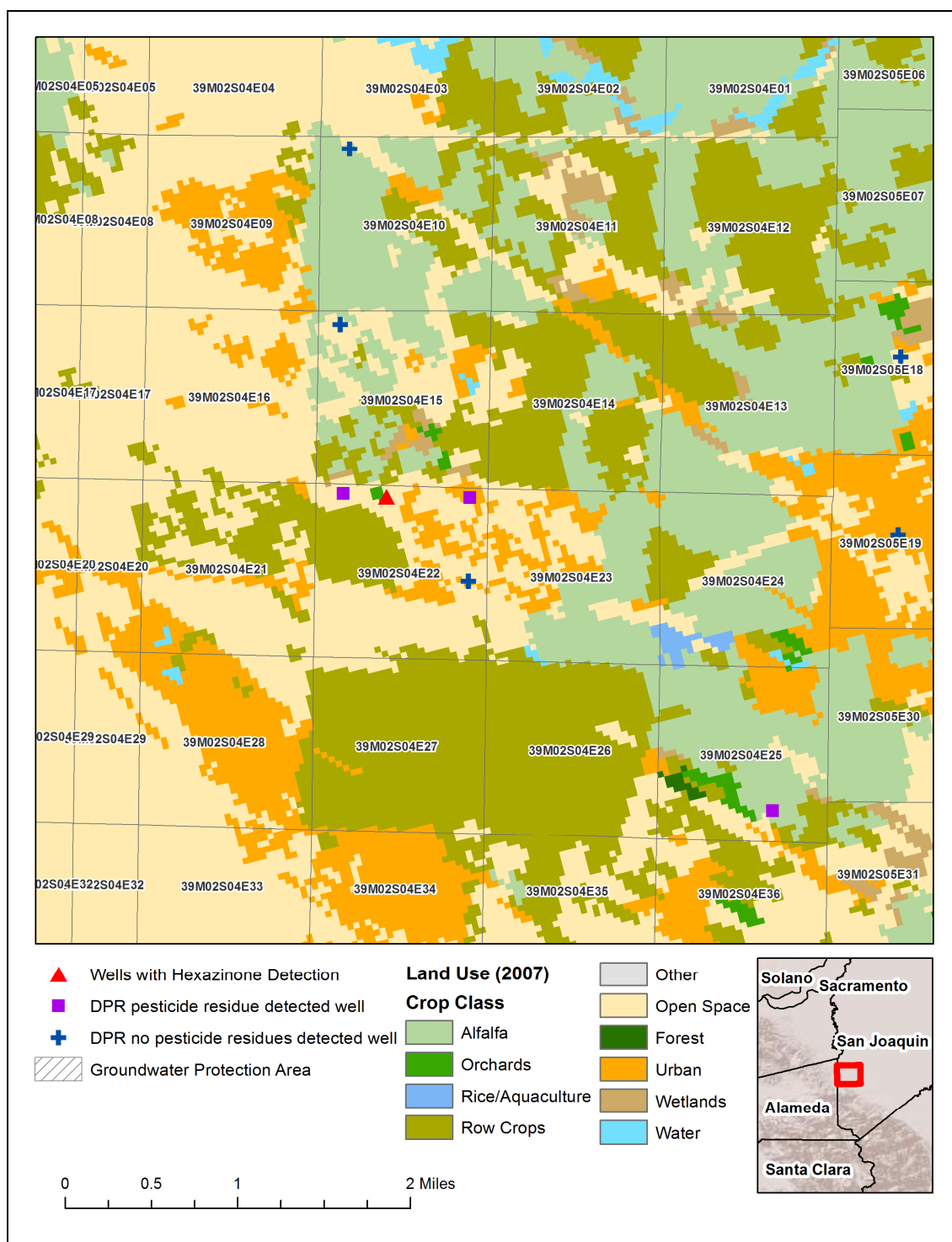


FIGURE 24 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 39M02S04E22

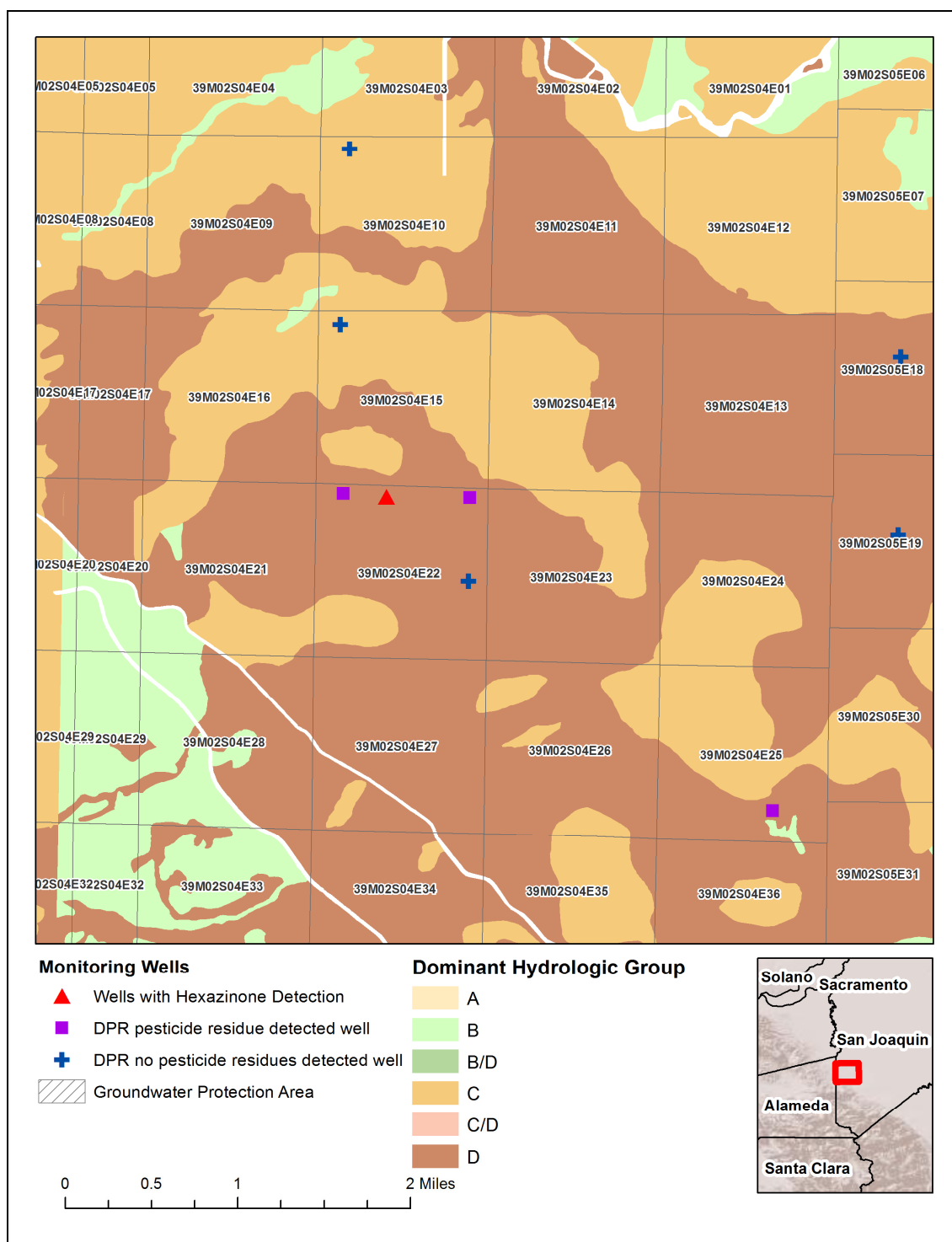


FIGURE 25 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 48M06N01E23

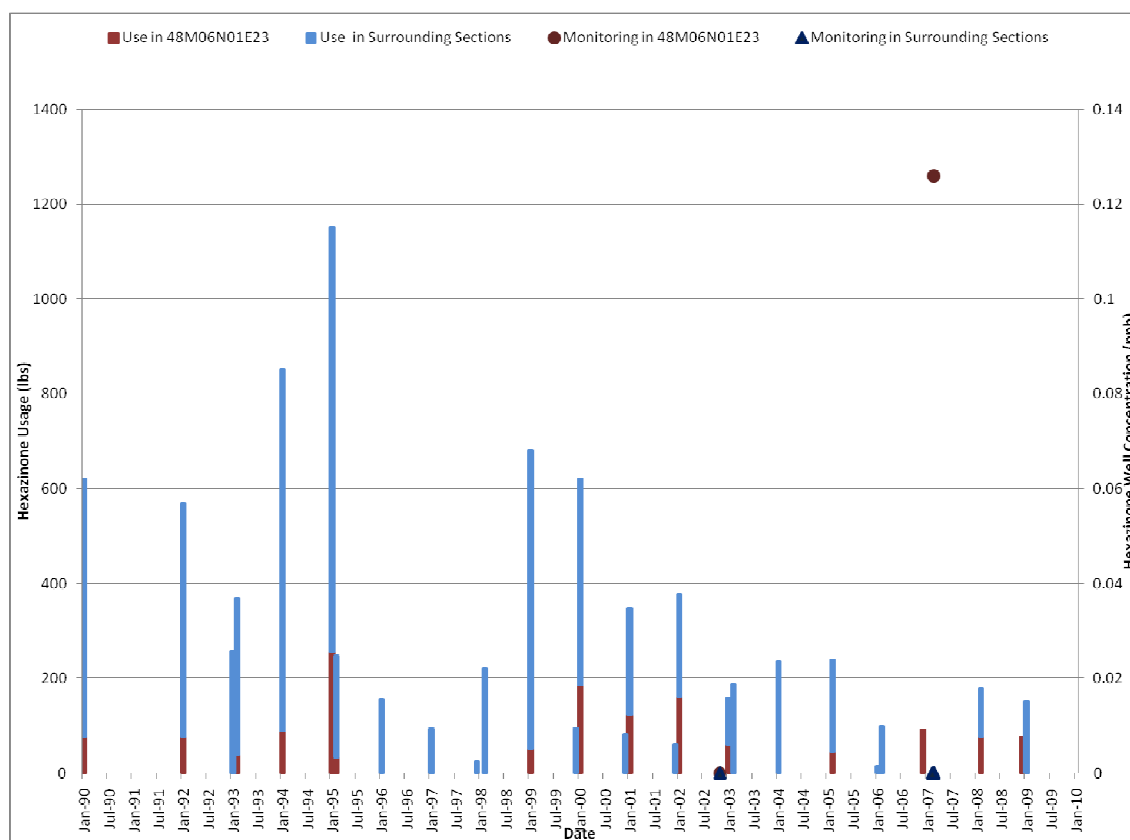


FIGURE 26 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 48M06N01W36

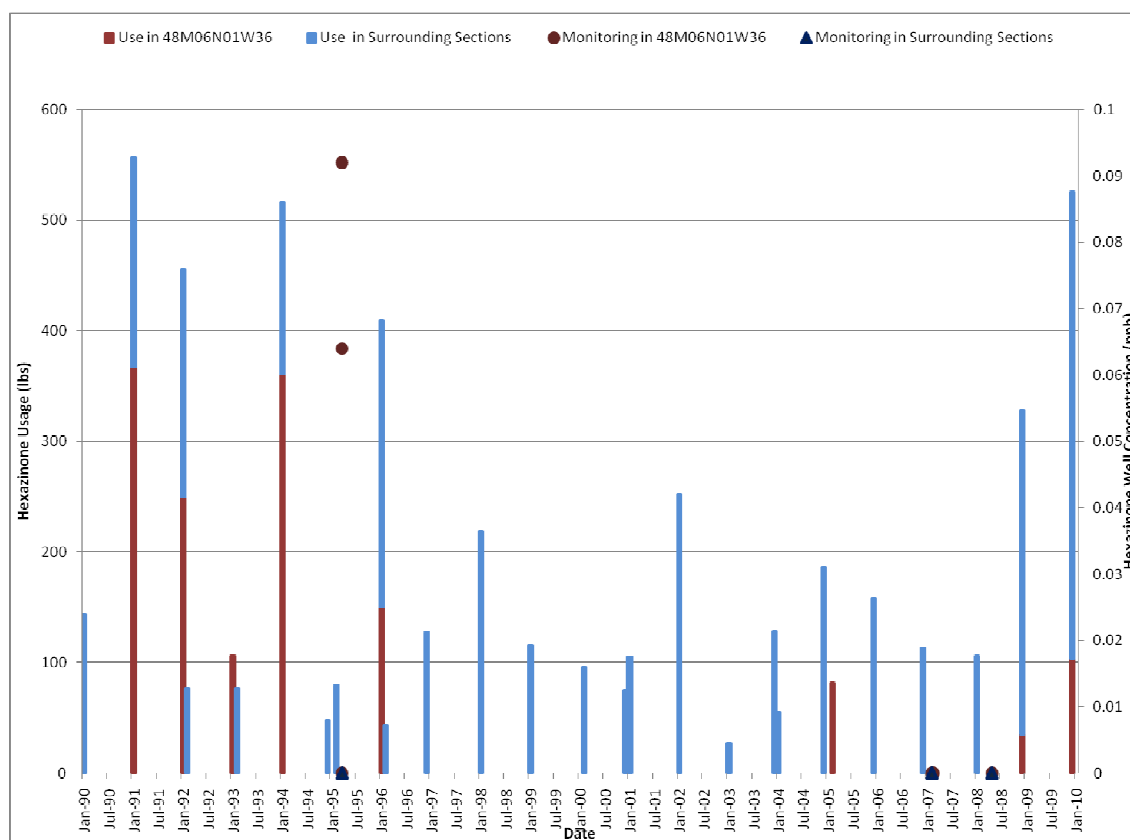


FIGURE 27 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 48M06N01E05

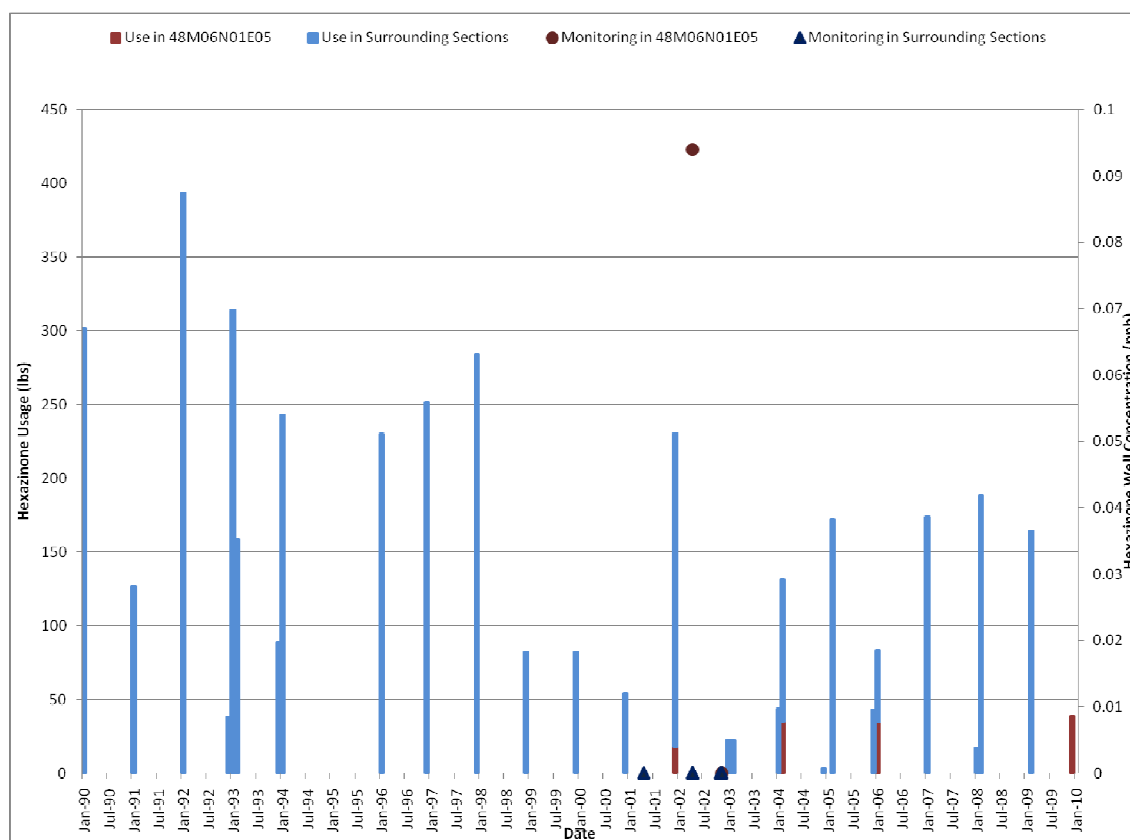


FIGURE 28 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 48M06N01E23, 48M06N01W36, AND 48M06N01E05

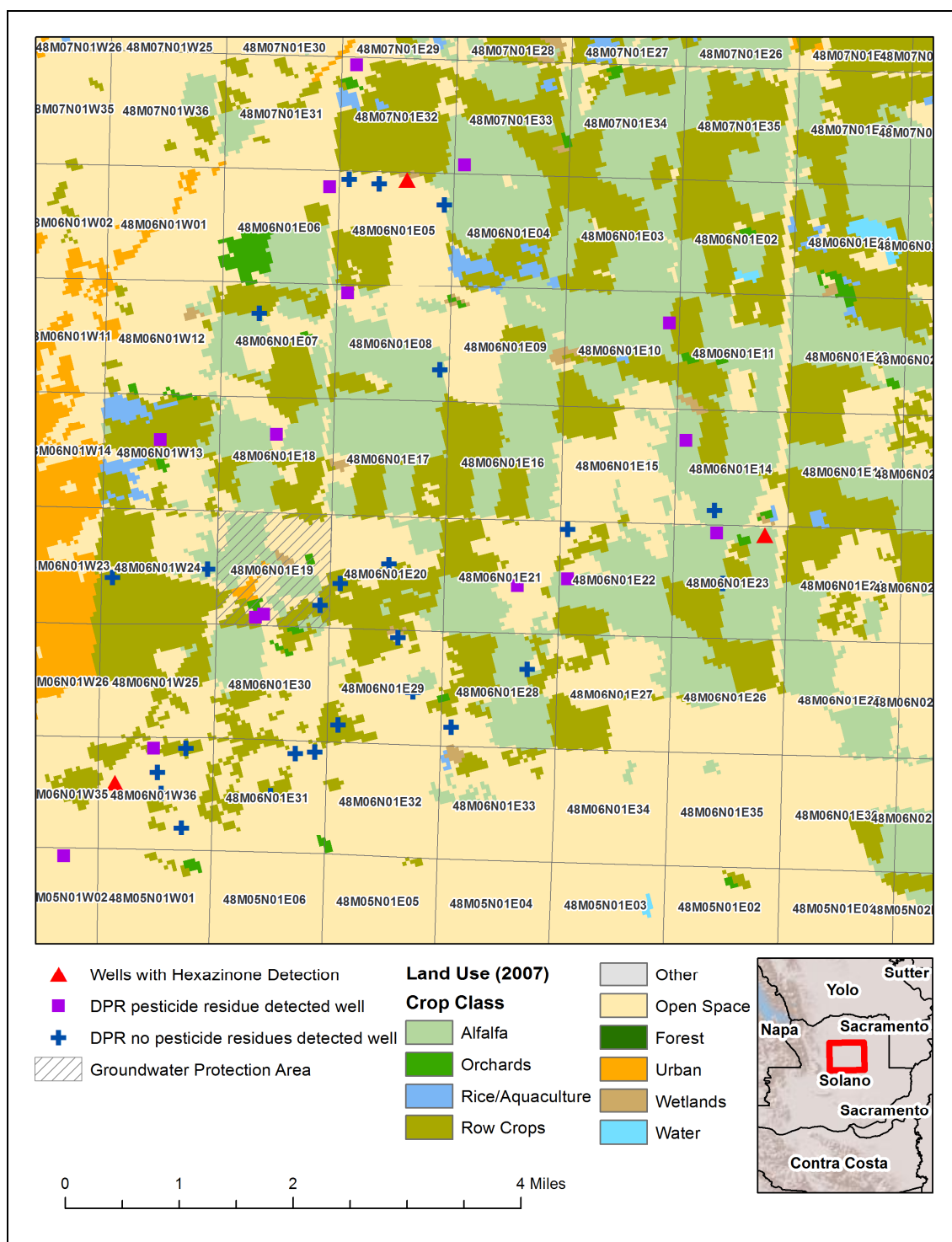


FIGURE 29 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 48M06N01E23, 48M06N01W36, AND
48M06N01E05

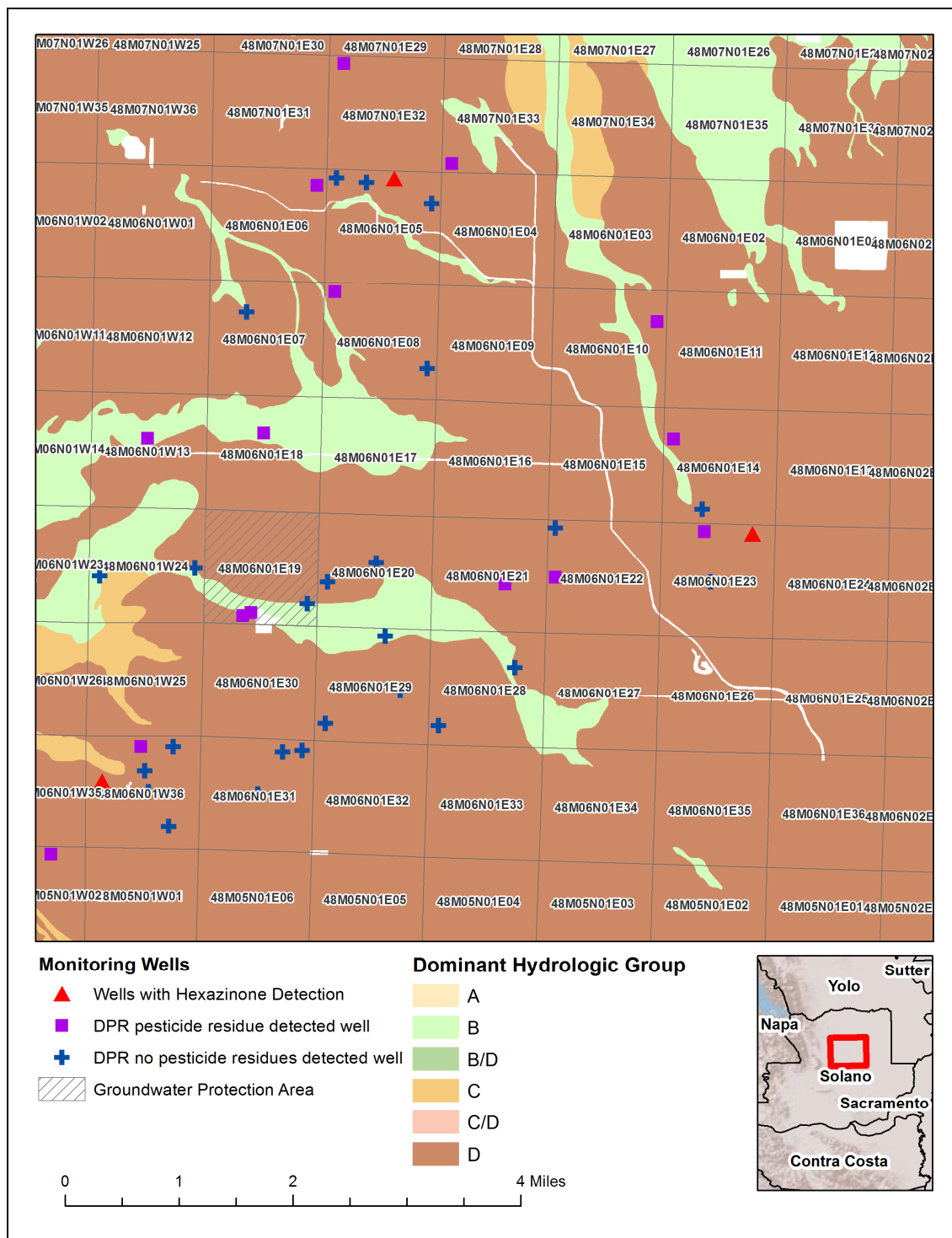


FIGURE 30 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 50M04S09E19

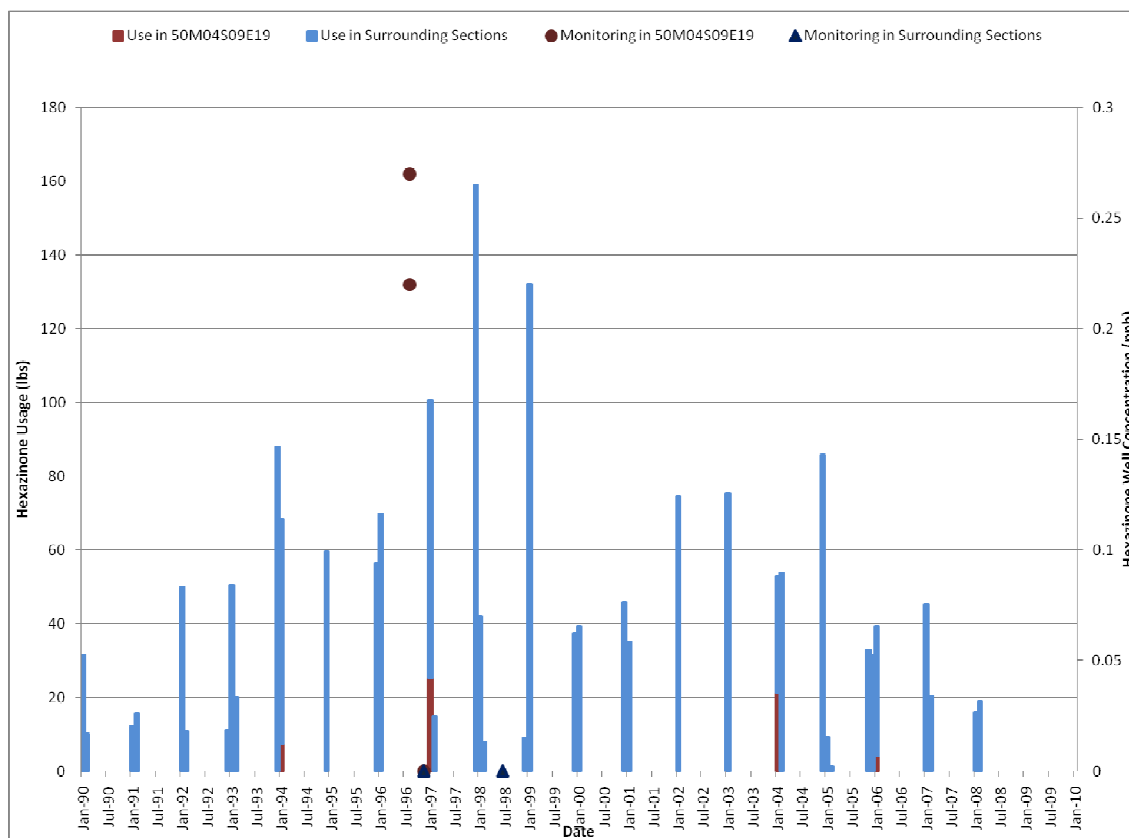


FIGURE 31 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 50M04S09E19

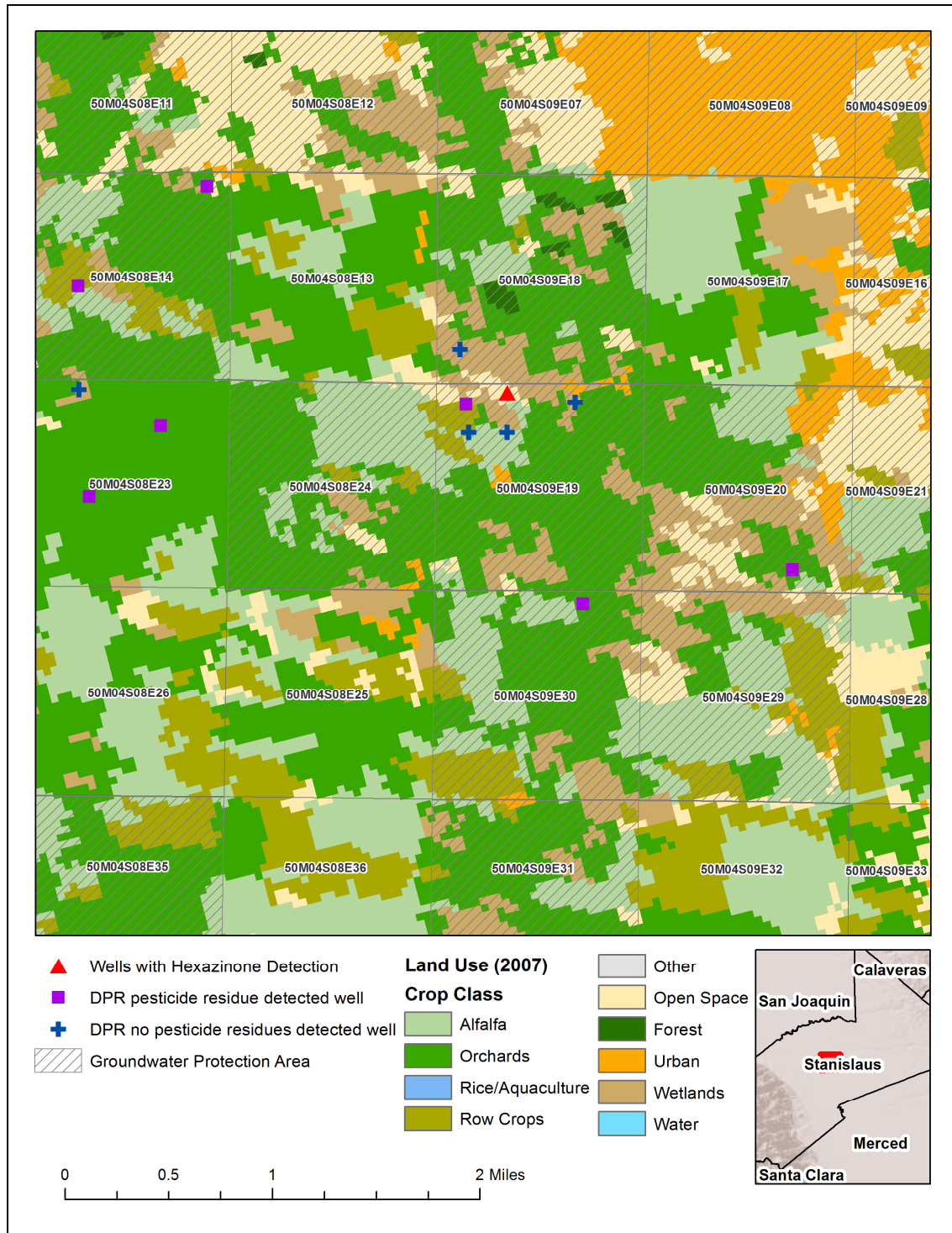


FIGURE 32 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 50M04S09E19

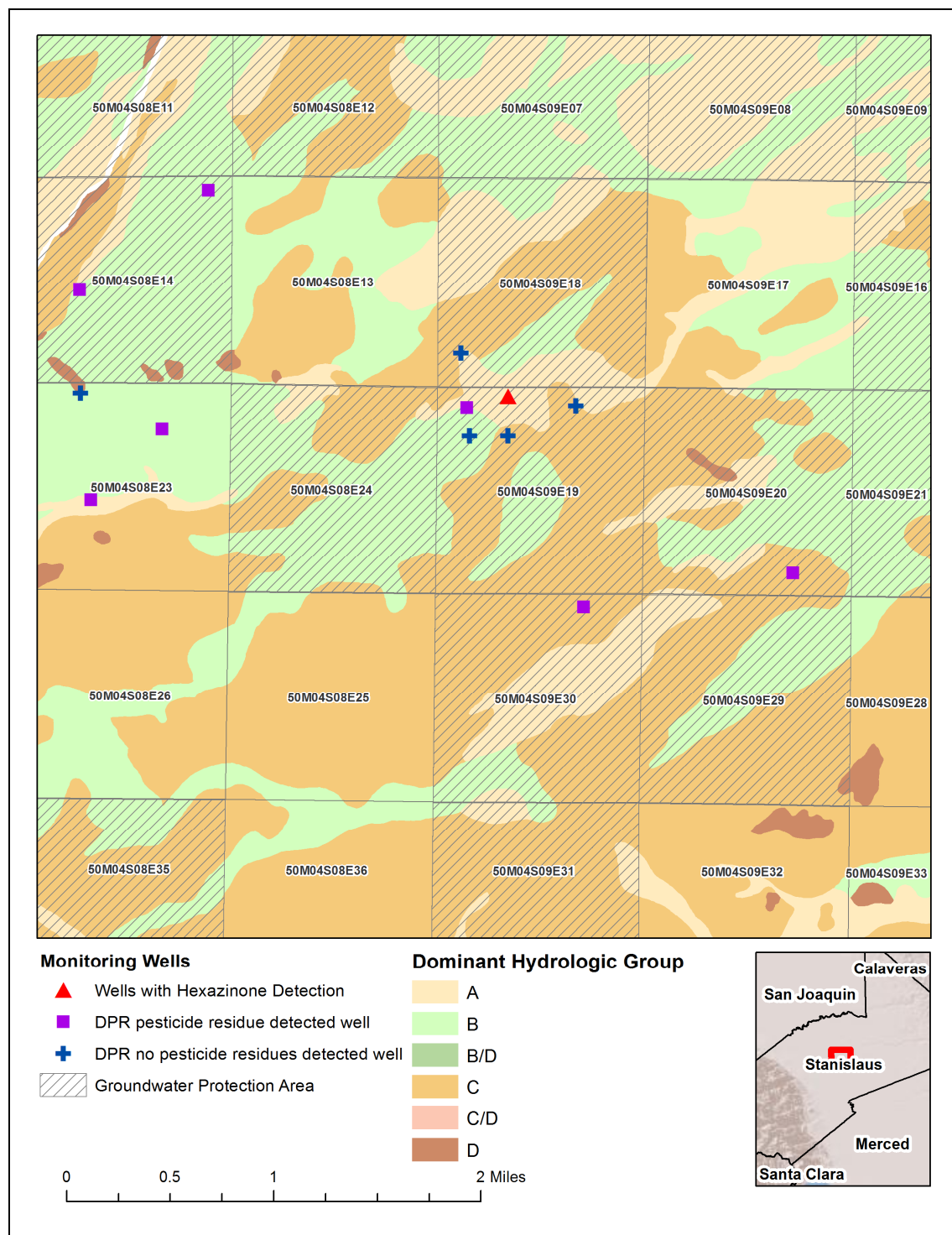


FIGURE 33 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 50M04S11E31

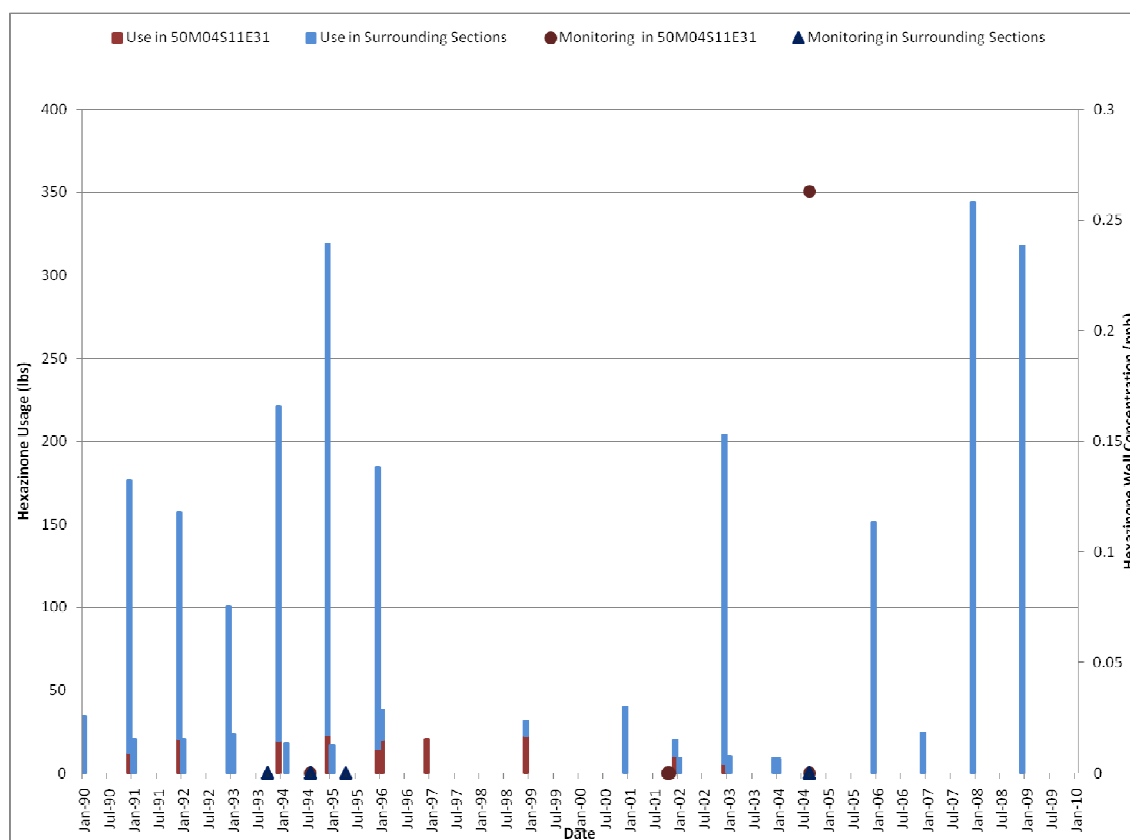


FIGURE 34 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 50M04S11E31

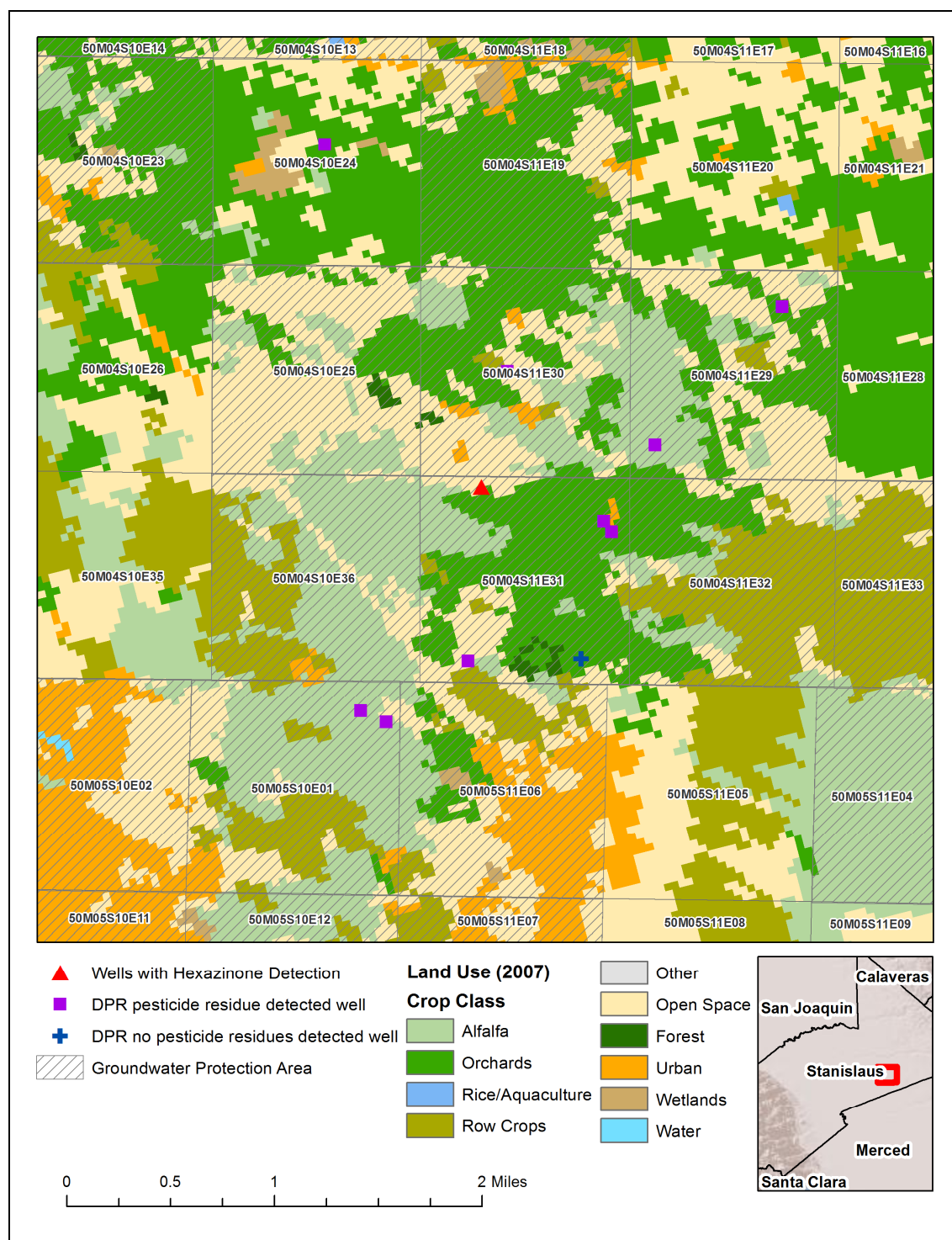


FIGURE 35 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 50M04S11E31

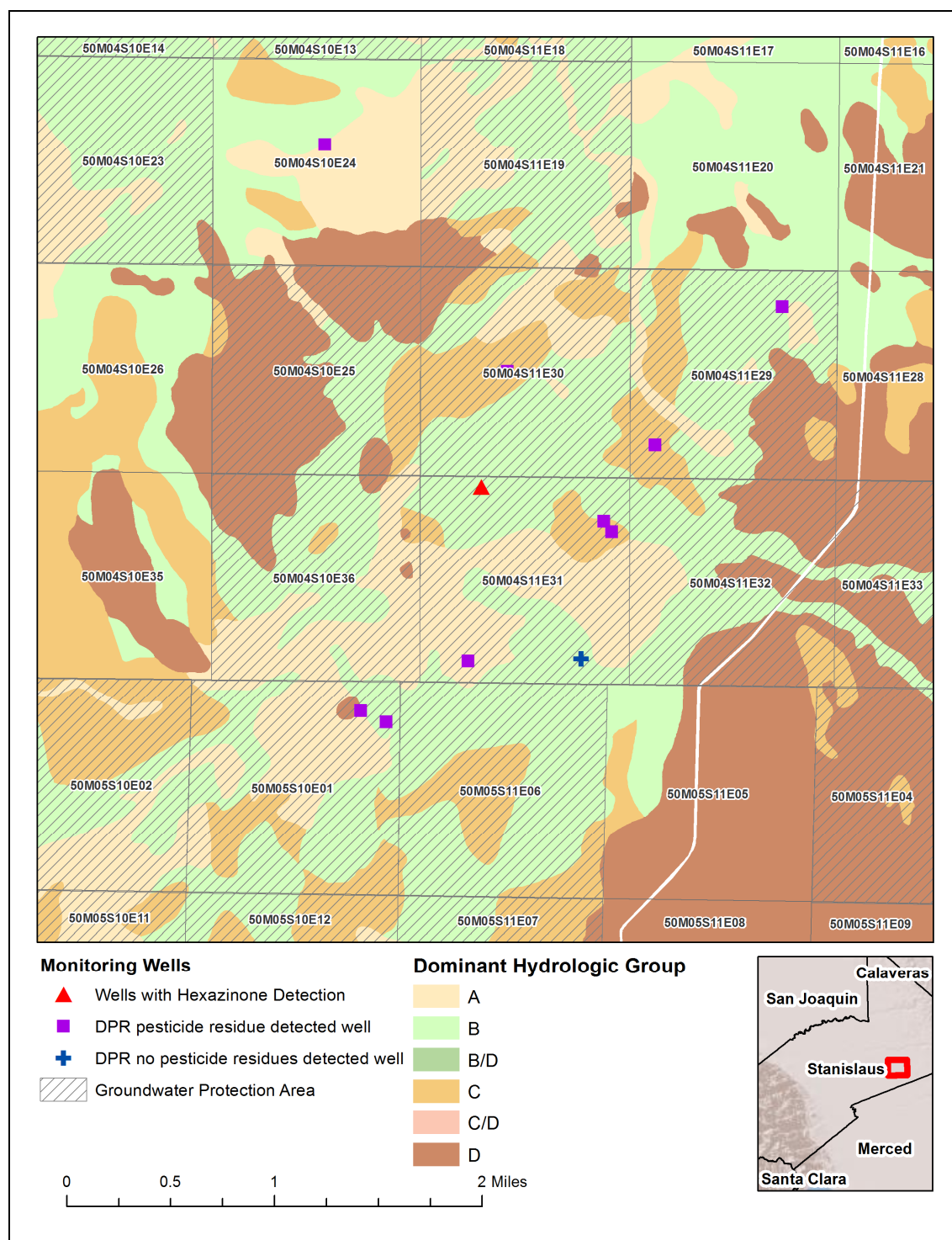


FIGURE 36 **MONTHLY USE AND MONITORING RESULTS IN AND AROUND**
LOCATION COMTRS 50M06S08E26

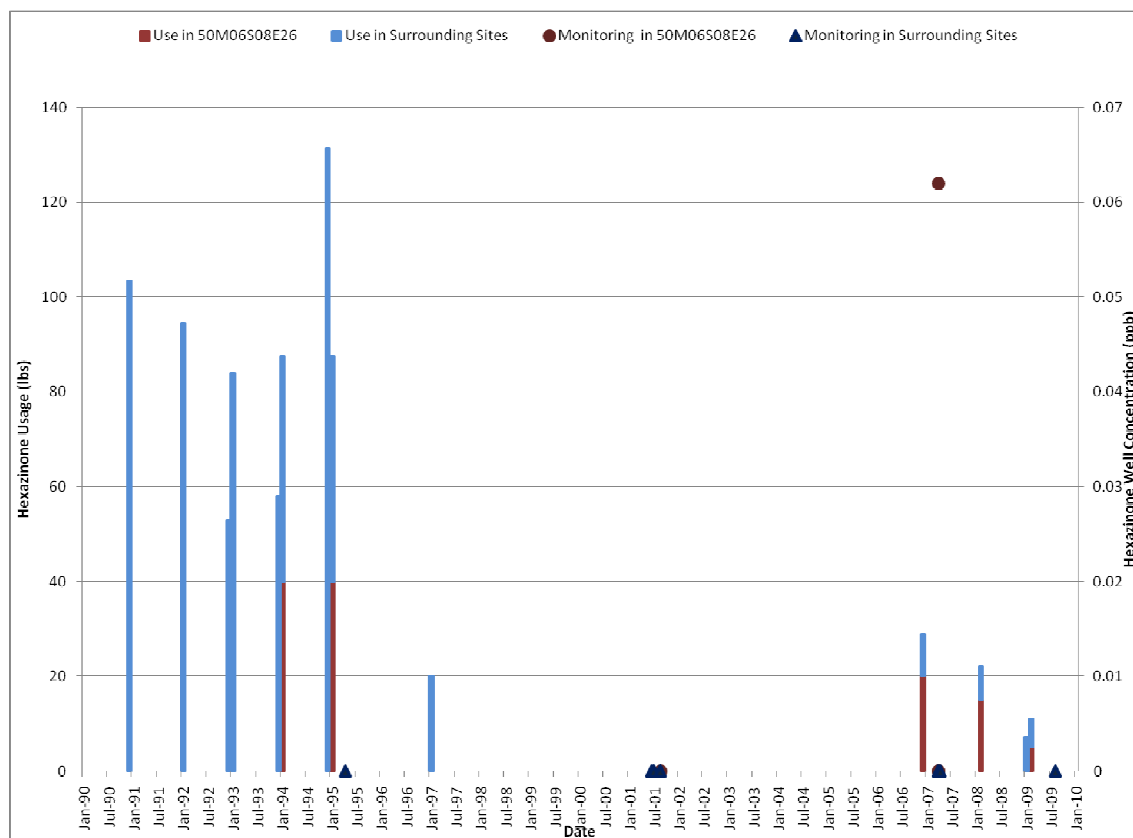


FIGURE 37 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 50M07S09E06

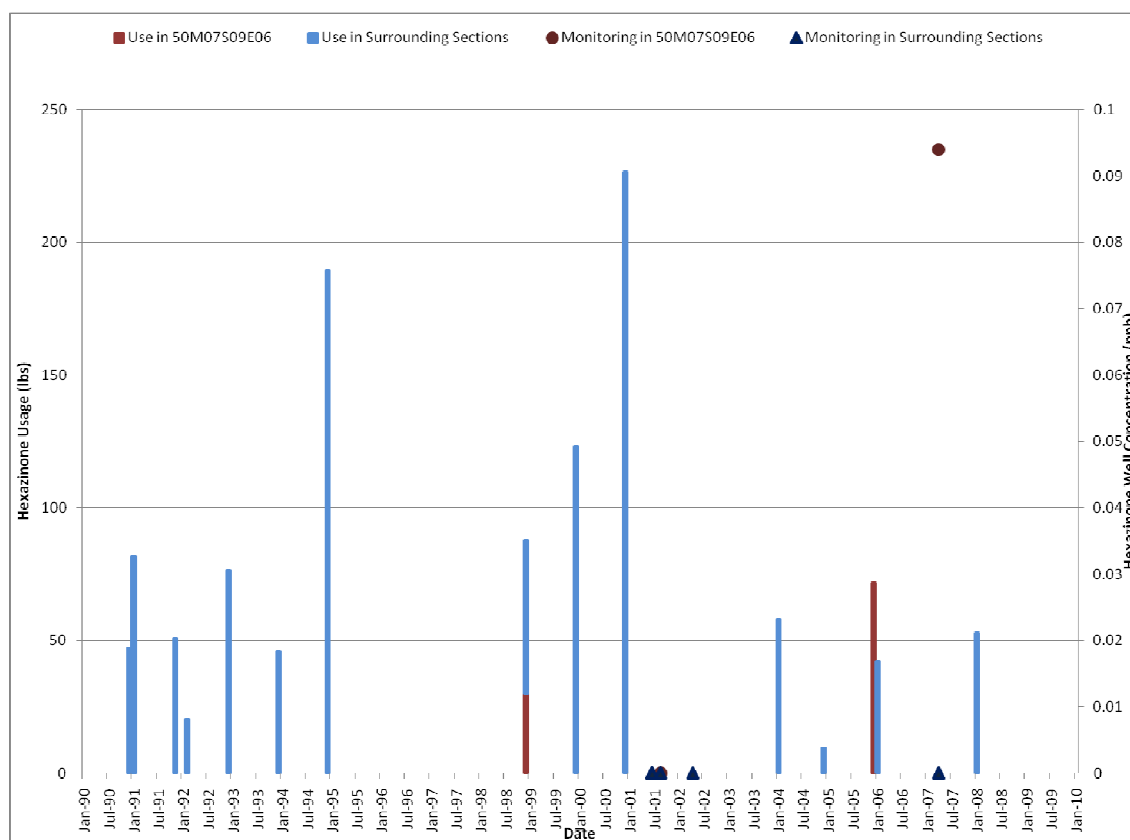


FIGURE 38 MONTHLY USE AND MONITORING RESULTS IN AND AROUND LOCATION COMTRS 50M07S08E14

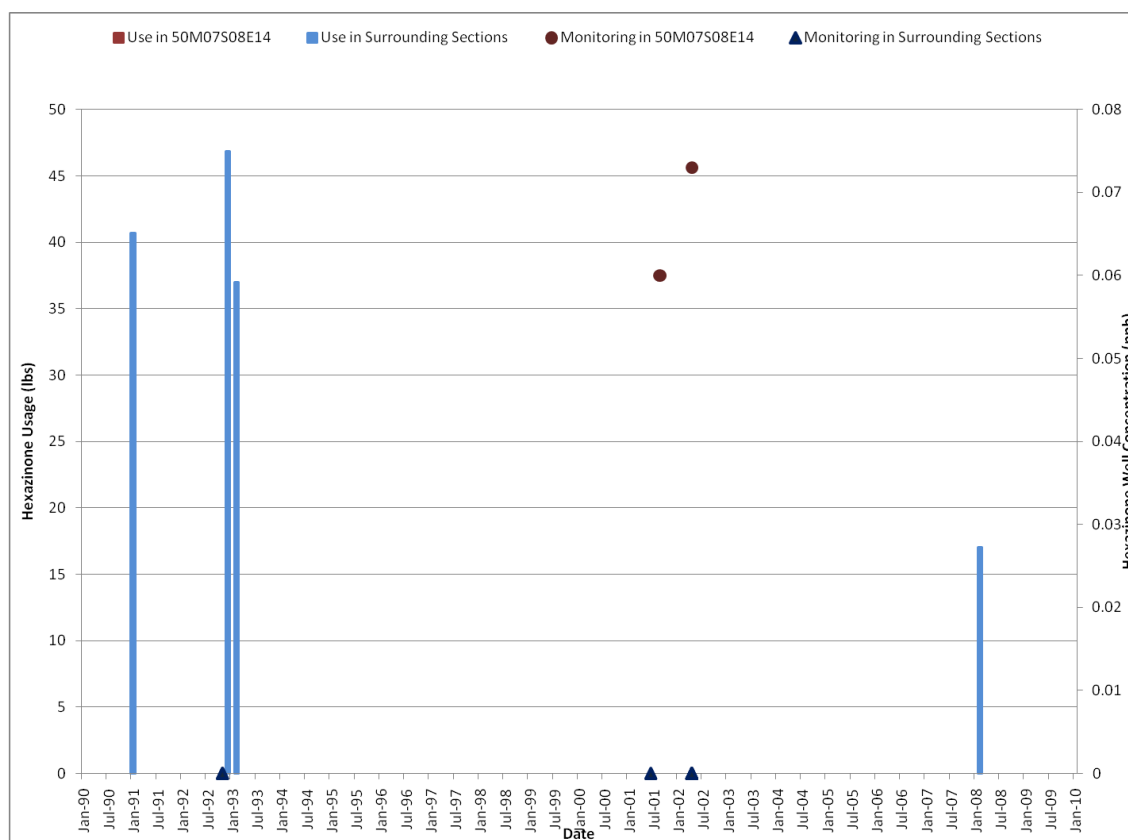


FIGURE 39 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 50M06S08E26, 50M07S09E06, AND 50M07S08E14

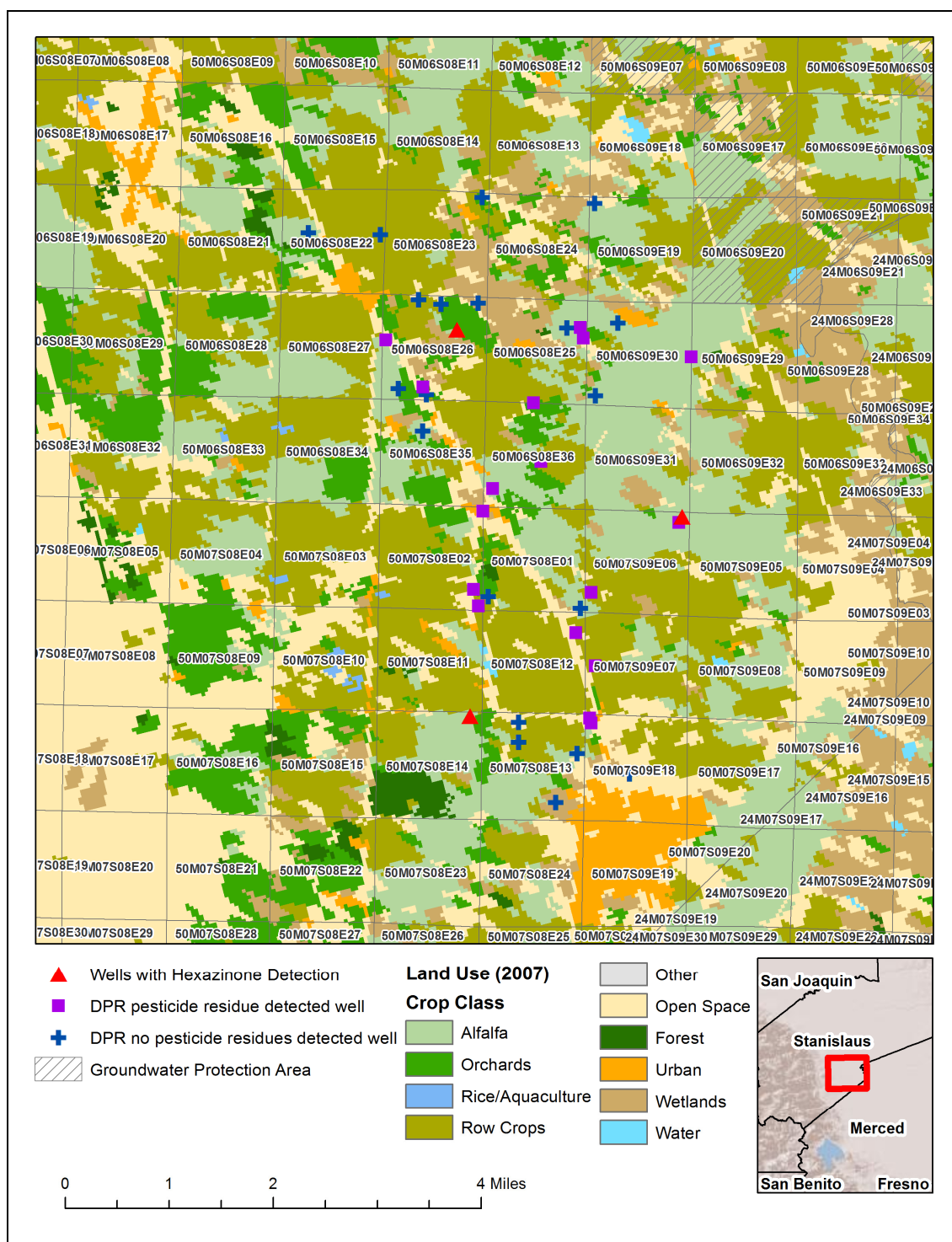


FIGURE 40 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 50M06S08E26, 50M07S09E06, AND
50M07S08E14

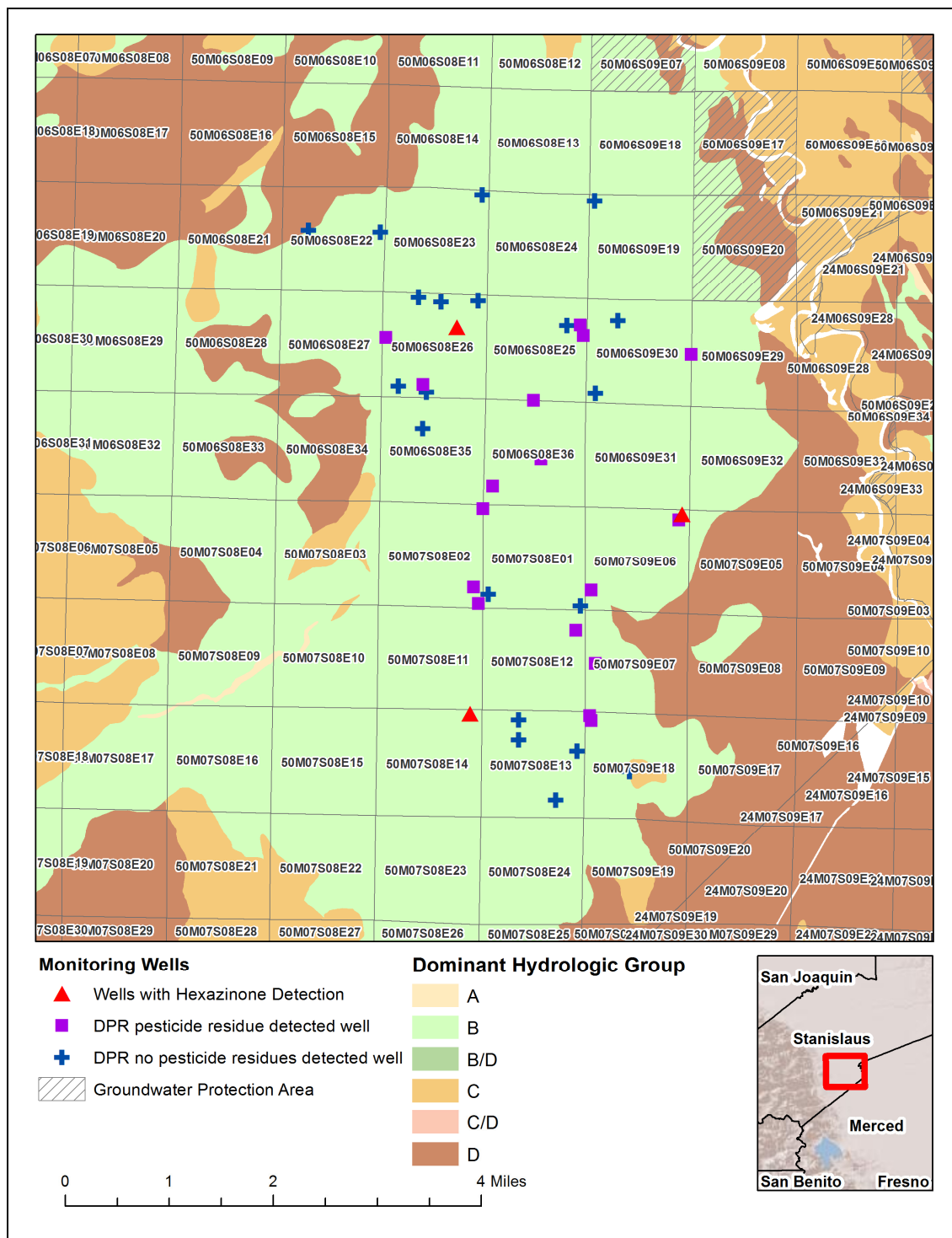


FIGURE 41 **MONTHLY USE AND MONITORING RESULTS IN AND AROUND**
LOCATION COMTRS 10M14S21E21

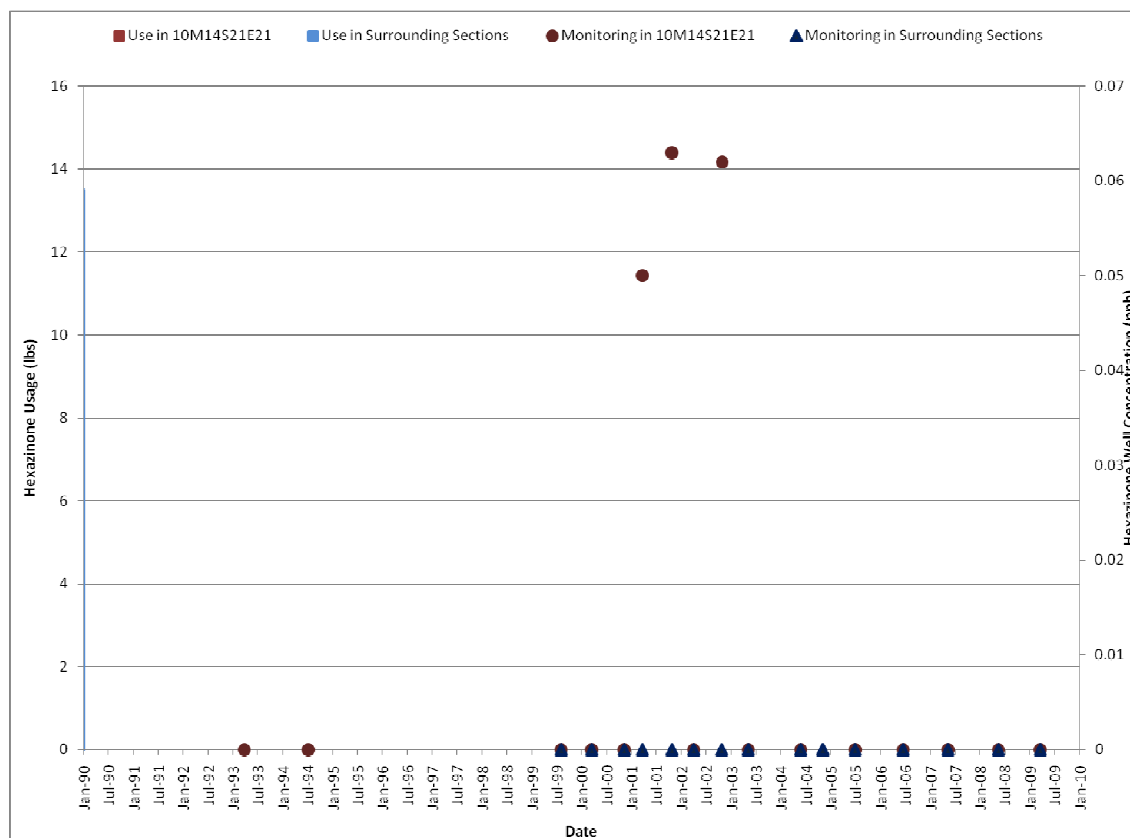


FIGURE 42 LAND-USE AND MONITORING LOCATIONS AROUND COMTRS 10M14S21E21

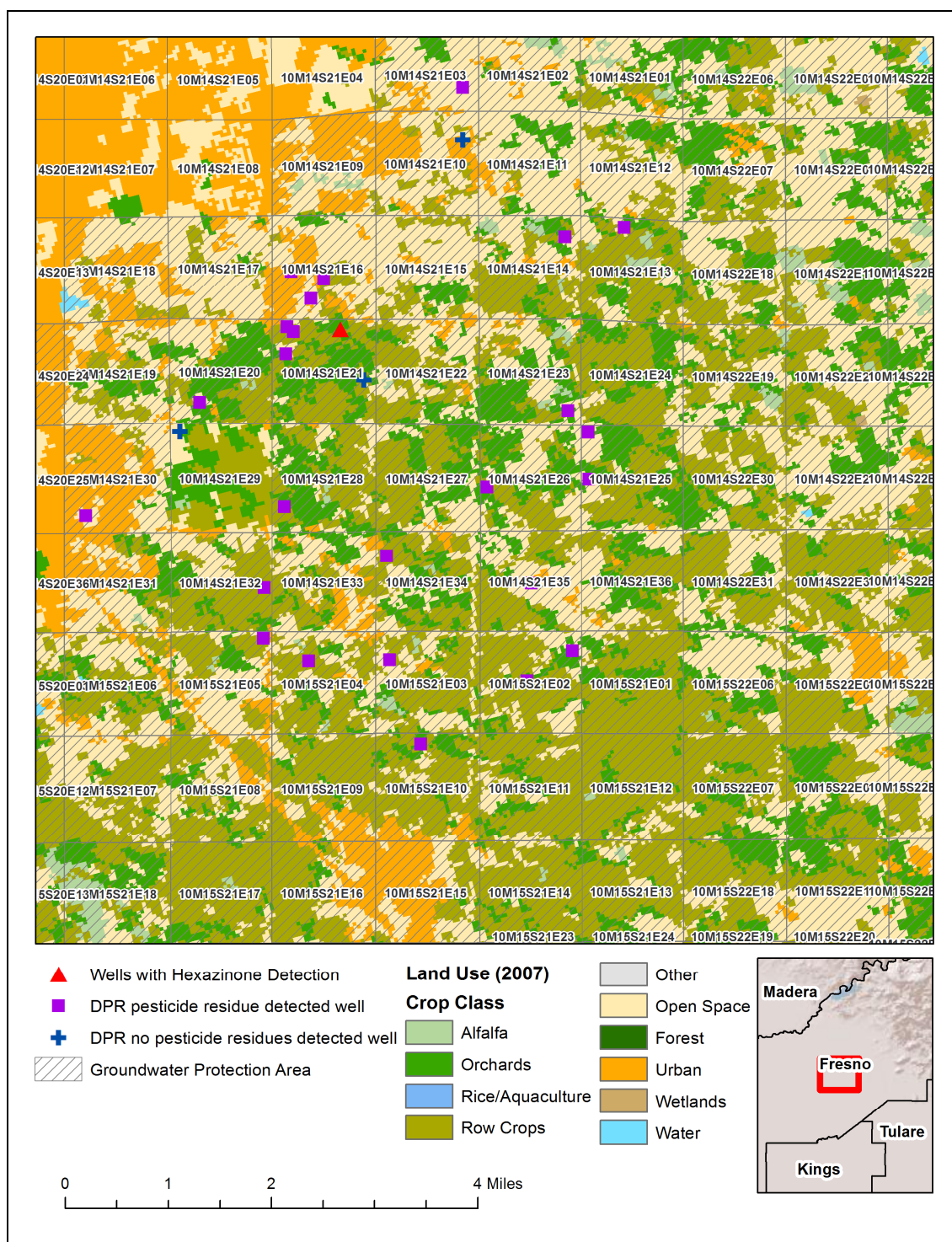


FIGURE 43 **HYDROLOGIC SOIL GROUP AND MONITORING LOCATIONS**
AROUND COMTRS 10M14S21E21

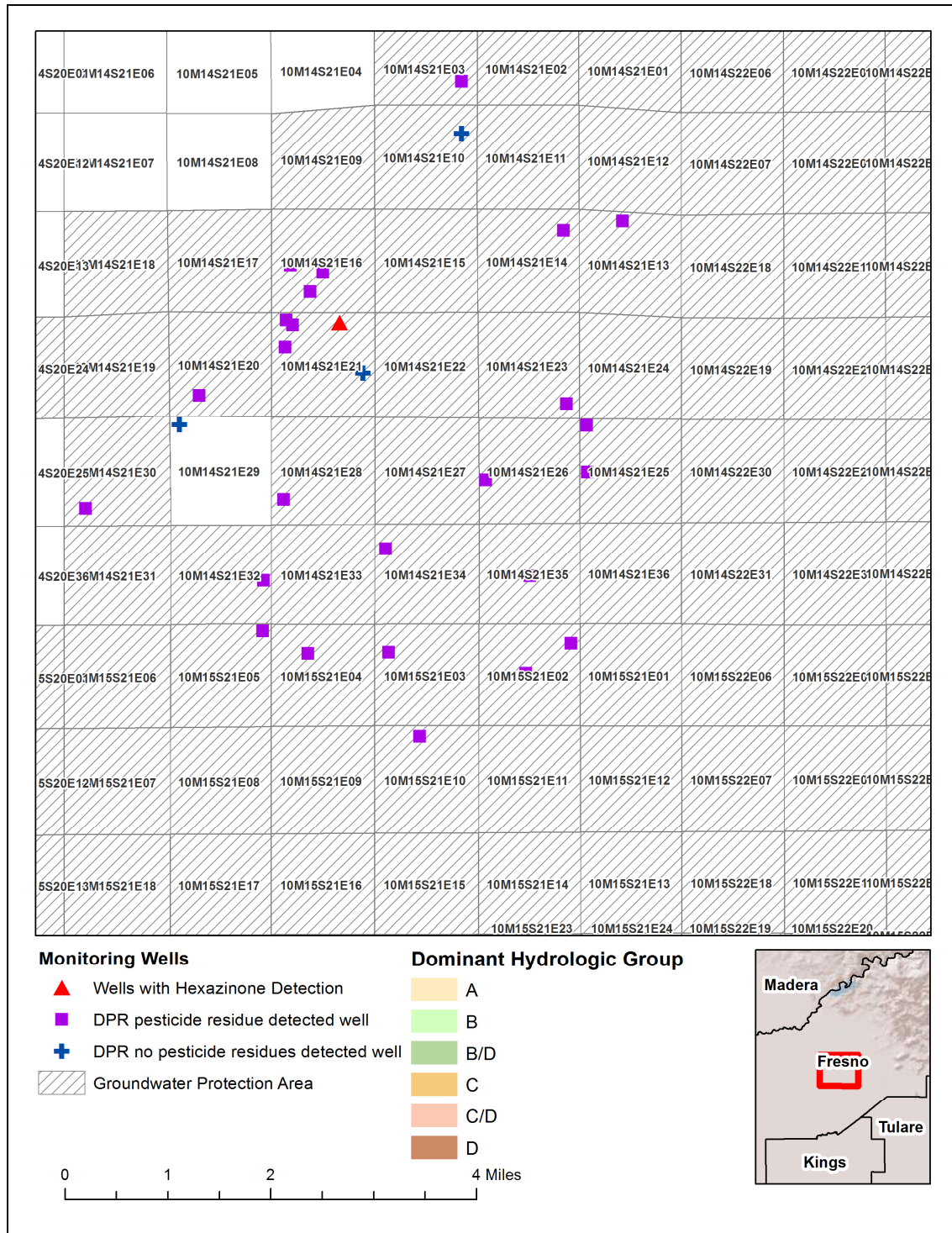


FIGURE 44 **PROJECTED GROUNDWATER CONCENTRATION USING DPR LEACHP TOOL; 125% TARGET IRRIGATION AND VARIABLE TRAVEL TIMES**

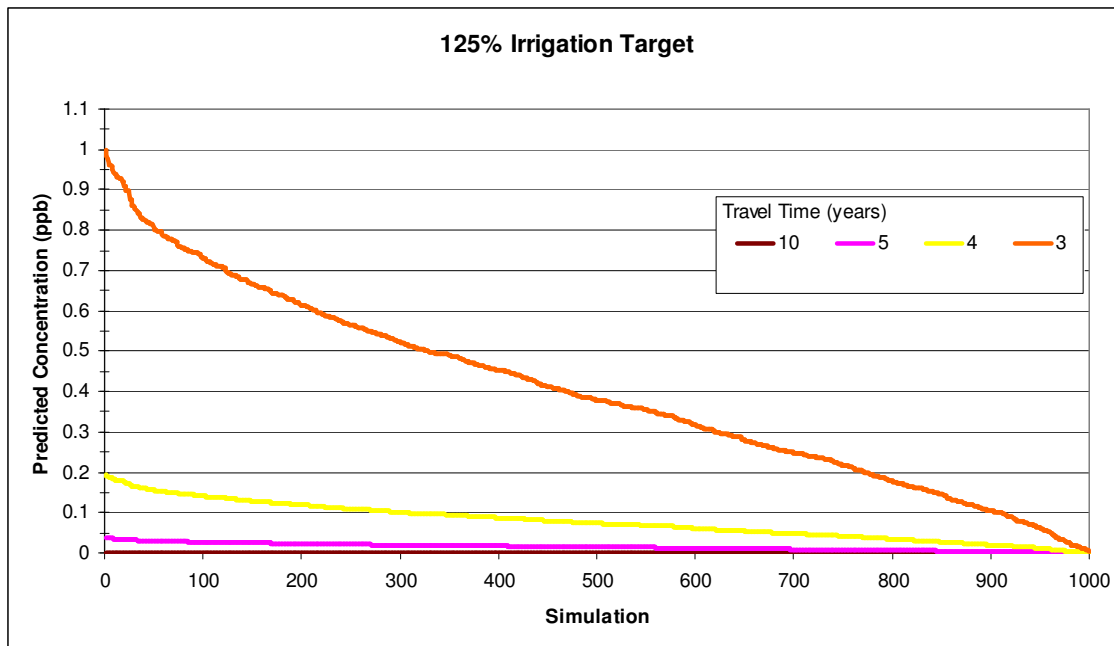


FIGURE 45 PROJECTED GROUNDWATER CONCENTRATION USING DPR LEACHP TOOL; 160% TARGET IRRIGATION AND VARIABLE TRAVEL TIMES

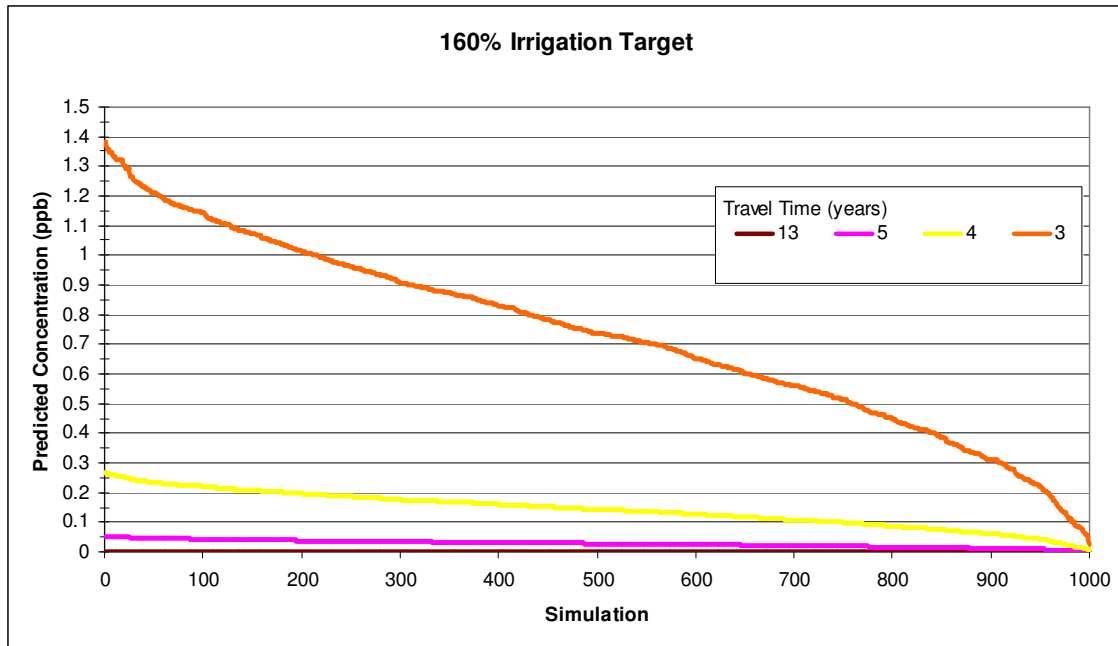


FIGURE 46 MAXIMUM PREDICTED WELL CONCENTRATION (3-YEAR TRAVEL TIME)

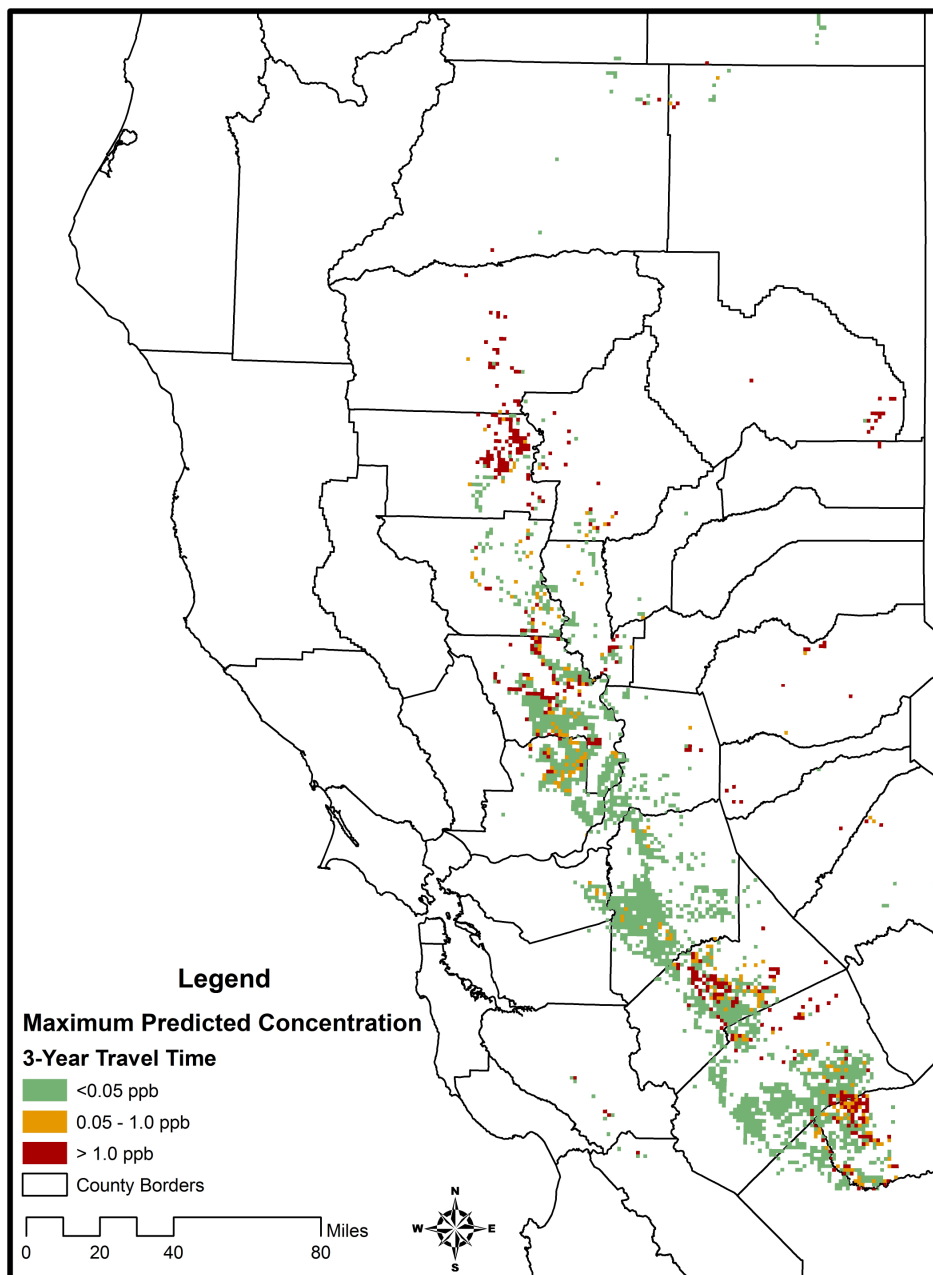


FIGURE 47 MAXIMUM PREDICTED WELL CONCENTRATION (4-YEAR TRAVEL TIME)

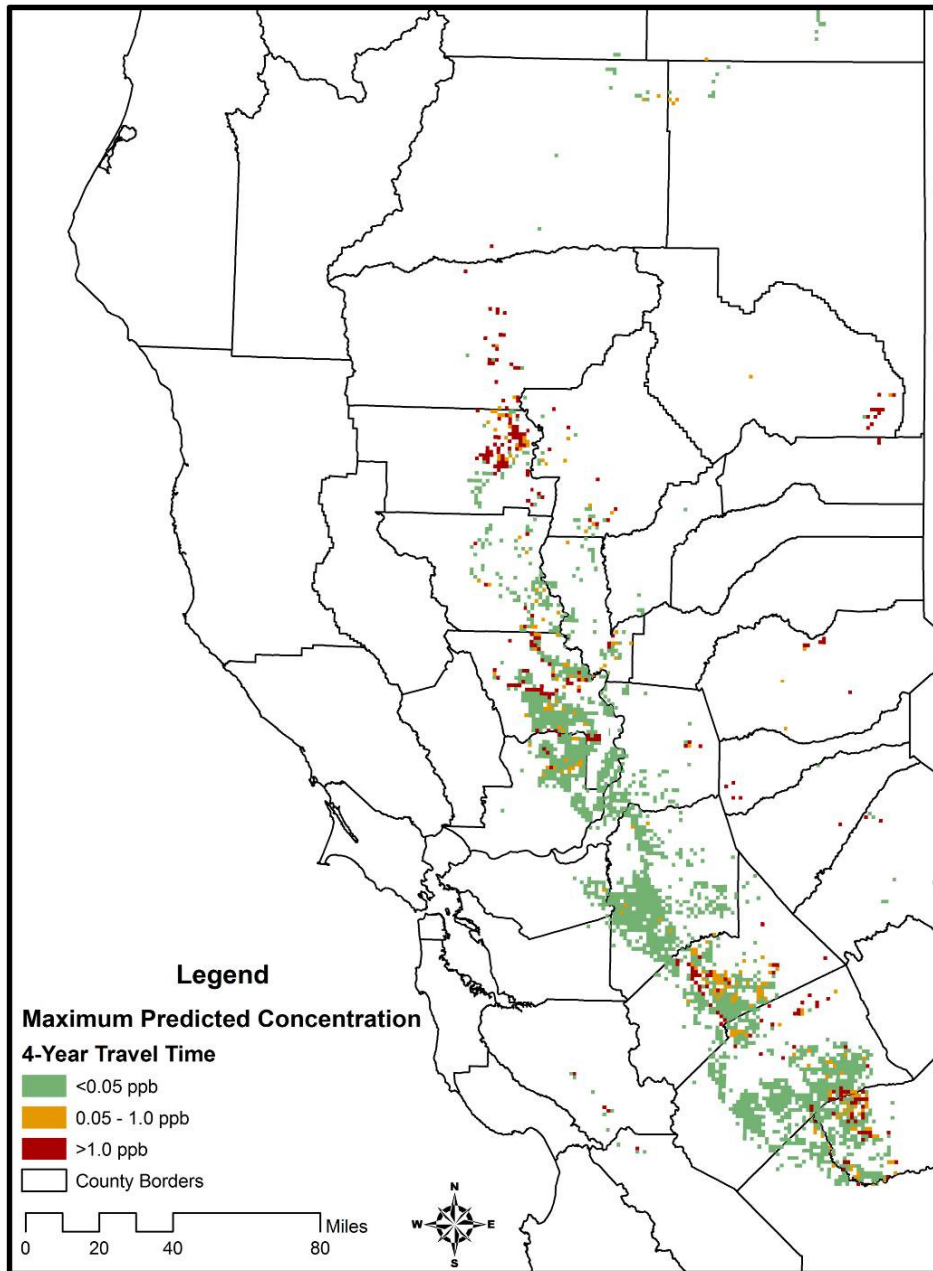


FIGURE 48 MAXIMUM PREDICTED WELL CONCENTRATION (5-YEAR TRAVEL TIME)

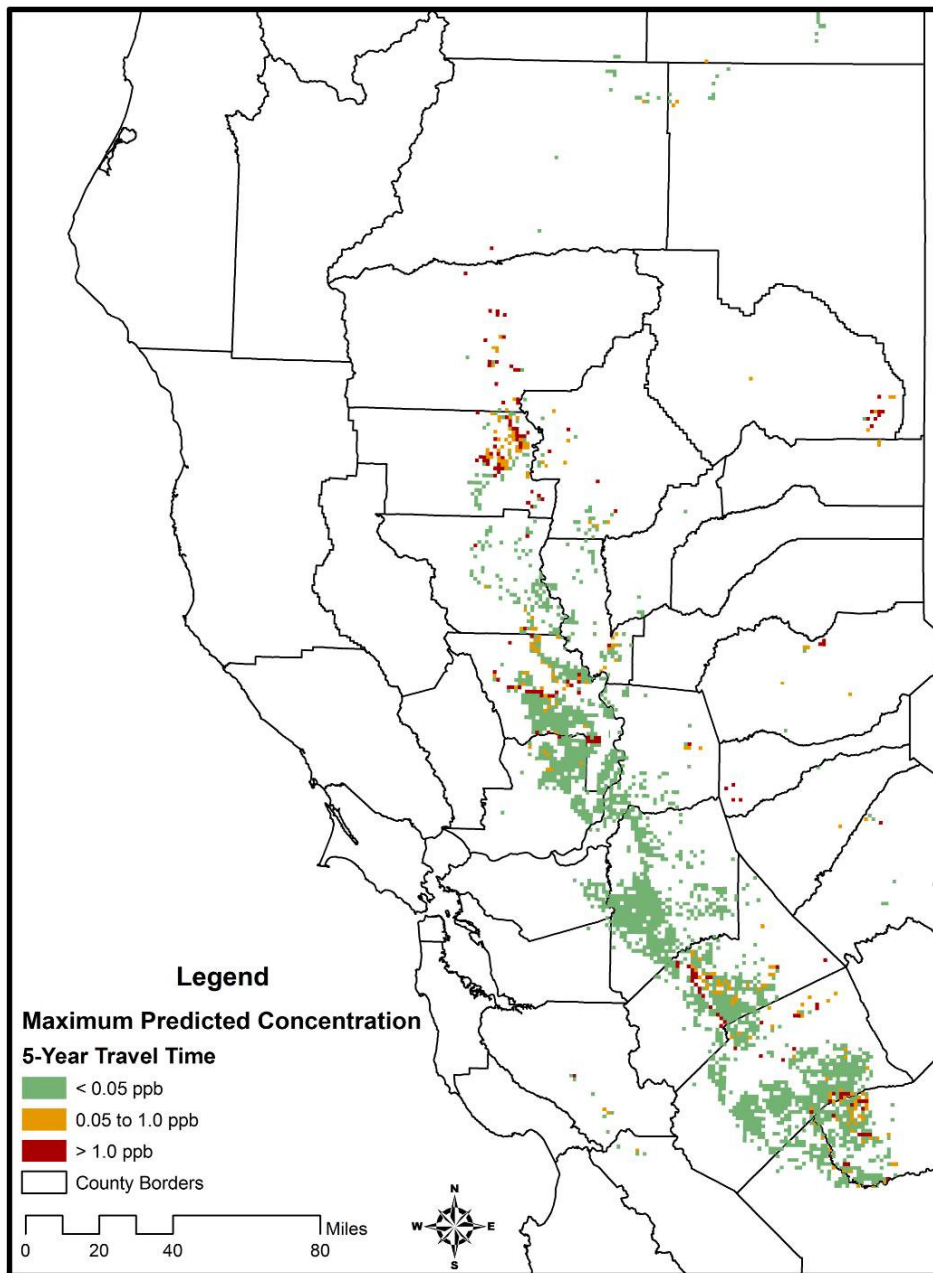


FIGURE 49 MAXIMUM PREDICTED WELL CONCENTRATION (10-YEAR TRAVEL TIME)

